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Environmental
Management
Division

Superfund Record of Decision:

"Closing with Dignity"

Sacramento Army Depot
Basewide
Sacramento, California

January 8, 1995

RECORD OF DECISION
SADA -- BASEWIDE

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PART I - DECLARATION

I. DECLARATION

SITE NAME AND LOCATION

Basewide
Sacramento Army Depot (SADA)
8350 Fruitridge Road
Sacramento, California

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected basewide remedial action for the Sacramento Army Depot facility in Sacramento, California, which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is documented in the administrative record for this site, which contains, among other documents:

- The Basewide Remedial Investigation Report (RI), which summarizes site investigation data;
- The Basewide Feasibility Study (FS), which contains an analysis of remedial alternatives;
- The Basewide Health Risk Assessment and Ecological Risk Assessment which contain an evaluation of impact on human health and the environment;
- The Basewide Proposed Plan (PP), dated November/December 1994, which summarizes the preferred cleanup alternative, compares the preferred alternative with several other alternatives, and invites public participation; and
- Summaries of public comments on the RI/FS and the PP, including the Army's response to comments (as Part III of this ROD).

The purpose of this Basewide Record of Decision (ROD) is 1) to set forth the remedial action to be conducted at SADA to remedy soil and groundwater contamination, 2) to amend two previous RODs which addressed Operable Unit cleanups at SADA, and 3) to explain the areas where no action/no further action will be taken. This is the final, comprehensive remedial action addressing soil and groundwater contamination at SADA. It addresses potential threats posed by conditions at SADA, both on and off site.

The U.S. Environmental Protection Agency, Region IX (EPA) and the State of California Environmental Protection Agency (Cal-EPA) concur with the selected remedy.

ASSESSMENT OF THE SITE

The Sacramento Army Depot site includes multiple areas with soil and groundwater contamination. Past operations at SADA involved the use of hazardous substances, including organic solvents, oils and grease, fuels, lubricants, caustic solutions and metal-plating baths. Some of these wastes or by-products have been found in soil and groundwater at the site.

In order to accelerate the investigation and cleanup of the site, the Army prioritized areas of the depot for investigation based on historical evidence indicating a potential for contamination. Eight areas were initially given priority for investigation. Four of these areas, South Post Groundwater, Tank 2, Oxidation Lagoons, and South Post Burn Pits, were investigated as operable units and addressed by operable unit Records of Decision. Thirteen areas were evaluated as potential Solid Waste Management Units (SWMUs), and an additional twenty nine areas, which were not potential SWMUs, were also evaluated. Three additional areas of potential concern, Parking Lot 3, Freon Spill Area, and Contractors Spoils Area, were also investigated.

The site investigations indicated that groundwater in the South Post area and at Parking Lot 3 is contaminated with volatile organic compounds, including carbon tetrachloride, trichloroethene (TCE), tetrachloroethene (PCE), 1,2-dichloroethane (DCA), and cis-1,2-dichloroethene (DCE). VOCs exceed the cleanup standards (drinking water Maximum Contaminant Levels) in an estimated 1,095 million gallons of water in the Southpost area and 82 million gallons of water in the Parking Lot 3 area. The maximum concentrations currently measured anywhere on site are TCE at 38 ug/l, PCE at 37 ug/l, DCA at 4.2 ug/l, DCE at 14 ug/l and carbon tetrachloride at 1.3 ug/l. The plume of contaminated water extends off-base, to approximately 1900 feet south of the depot's southern property boundary.

Metals contamination is present at the following areas: Oxidation Lagoons, South Post Burn Pits, Battery Disposal Well investigation-derived waste, and Building 300 Burn Pit. Chemicals of concern include arsenic, cadmium, chromium, and lead. The South Post Burn Pits are also contaminated with VOCs and are the source of the groundwater contamination in the South Post area. The South Post Burn Pits are known to contain debris such as cans, scrap metal, concrete and wood.

A basewide health risk assessment was conducted to evaluate the current and potential risks posed by the chemicals at each area of concern. The maximum combined carcinogenic risk to an "onsite worker" was found to be $6x10^{-5}$. Non-carcinogenic risk for an "onsite worker" was found to be low, as expressed by a health hazard index of 1.0. The maximum metals concentrations detected in soils may result in exposure levels that exceed the no observed adverse effects levels (NOAELs) and or the lowest observed adverse effect levels (LOAELs) for potential ecological receptors.

Based on the site assessment and risk evaluations it has been determined that the contaminants present at the site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to the public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

The Army intends to clean up those areas that present a threat to human health and the environment. The selected remedy for cleanup of groundwater and soil at SADA consists of:

Groundwater

- In the South Post area, one vertical off-depot well and two horizontal Zone A/B off-depot wells will be installed to capture the off-depot plume more quickly. A deeper C-Zone well will be added to pump this zone more rapidly. The existing treatment facility will be modified to accept increased flowrate of up to 450 gpm. Extracted water will be discharged through the current treatment process and be available for onsite reuse. Additional or fewer wells may be installed based on detailed design using field test results.

- At Parking Lot 3, vertical Zone A/B extraction wells, one or more based on detailed design, will be installed to capture the groundwater. Extracted water will be treated at the wellheads using activated carbon and then discharged to the sanitary sewer.

Soil

- The soil venting system at the South Post Burn Pits will be shut down as explained in the South Post Burn Pits ROD Amendment contained in Section 9.4.

- A Corrective Action Management Unit (CAMU) will be formed at the South Post Burn Pits area for stabilization of soil containing heavy metals and other contaminants and to the extent feasible, the debris. Debris which cannot be stabilized will be properly disposed of offsite. This amendment to the South Post Burn Pits ROD will allow soils from other areas of SADA to be stabilized at the South Post Burn Pits.

- At Building 300 Burn Pits, soil will be excavated and the soil and debris moved to the South Post Area for management with the South Post Burn Pits material in the CAMU.

- At the Battery Disposal Well, investigation-derived waste soil will be moved to the South Post Burn Pits for management in the CAMU.

- At the Oxidation Lagoons, the remedy will be changed from soil washing to soil excavation and transport to the South Post Burn Pits for management at the CAMU as explained in the Oxidation Lagoons ROD Amendment contained in Section 9.5.

- All other identified areas are No Action/No Further Action (see Plate 5). These areas have been assessed at the depot to provide data for a no action or no further action decision. Two areas were cleaned up under an extensive pilot test that utilized air sparging technology. These areas are Parking Lot 3 and the Freon 113 Area.

This selected remedy eliminates threats to human health and the environment at the site by removing volatile contaminants from groundwater by pumping the groundwater from the ground and destroying the VOCs in a treatment process. The selected remedy also provides for excavation of soil containing heavy metals and elimination of future potential exposures by stabilizing the soil with cement.

The estimated cost of the selected remedy is $6,344,000. The estimated cost of the next most likely alternative would be $8,997,000.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practical and satisfies the statutory preference for remedies that employ treatment that reduces the toxicity, mobility, or volume as a principle element.

SACRAMENTO ARMY DEPOT
BASEWIDE
RECORD OF DECISION

IT IS SO AGREED:
FOR THE U.S. DEPARTMENT OF THE ARMY:

1/12/95 Lewis D. Walker

Date

Lewis D. Walker
Deputy for Environmental, Safety,
and Occupational Health
Office of the Assistant Secretary of the Army

08 Jan 95 Todd E. Blose

Date

Todd E. Blose
LTC, OD
Commander, Sacramento Army Depot

08 JAN 95 Dan Oburn

Date

Dan Oburn
BRAC Environmental Coordinator
Sacramento Army Depot

FOR THE STATE OF CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY:

1-17-95 Anthony J. Landis

Date

Anthony J. Landis
Chief, Northern California Operations
Department of Toxic Substances Control
California Environmental Protection Agency

1-17-95 William H. Crooks

Date

William H. Crooks
Executive Officer
Central Valley Regional Water Quality Control Board

FOR THE U.S. ENVIRONMENTAL PROTECTION AGENCY:

1-17-95

Date

John Wise
Deputy Regional Administrator
United States Environmental Protection Agency, Region IX

PART II
DECISION SUMMARY

1 SITE NAME, LOCATION, AND DESCRIPTION

The Sacramento Army Depot Activity (SADA) is a military facility owned by the U.S. Army. The SADA facility is located at 8350 Fruitridge Road, in the City and County of Sacramento, California. SADA lies approximately 7 miles southeast of downtown Sacramento (Plate 1), and is bound by Fruitridge Road on the north, Florin-Perkins Road on the east, Elder Creek Road on the south, and the Southern Pacific Railroad tracks on the west. The facility encompasses an area of 485 acres.

SADA is on the Base Realignment and Closure (BRAC) list. Activities at SADA have been reassigned to other military installations and the base will be closed in 1995. The property will be transferred for reuse.

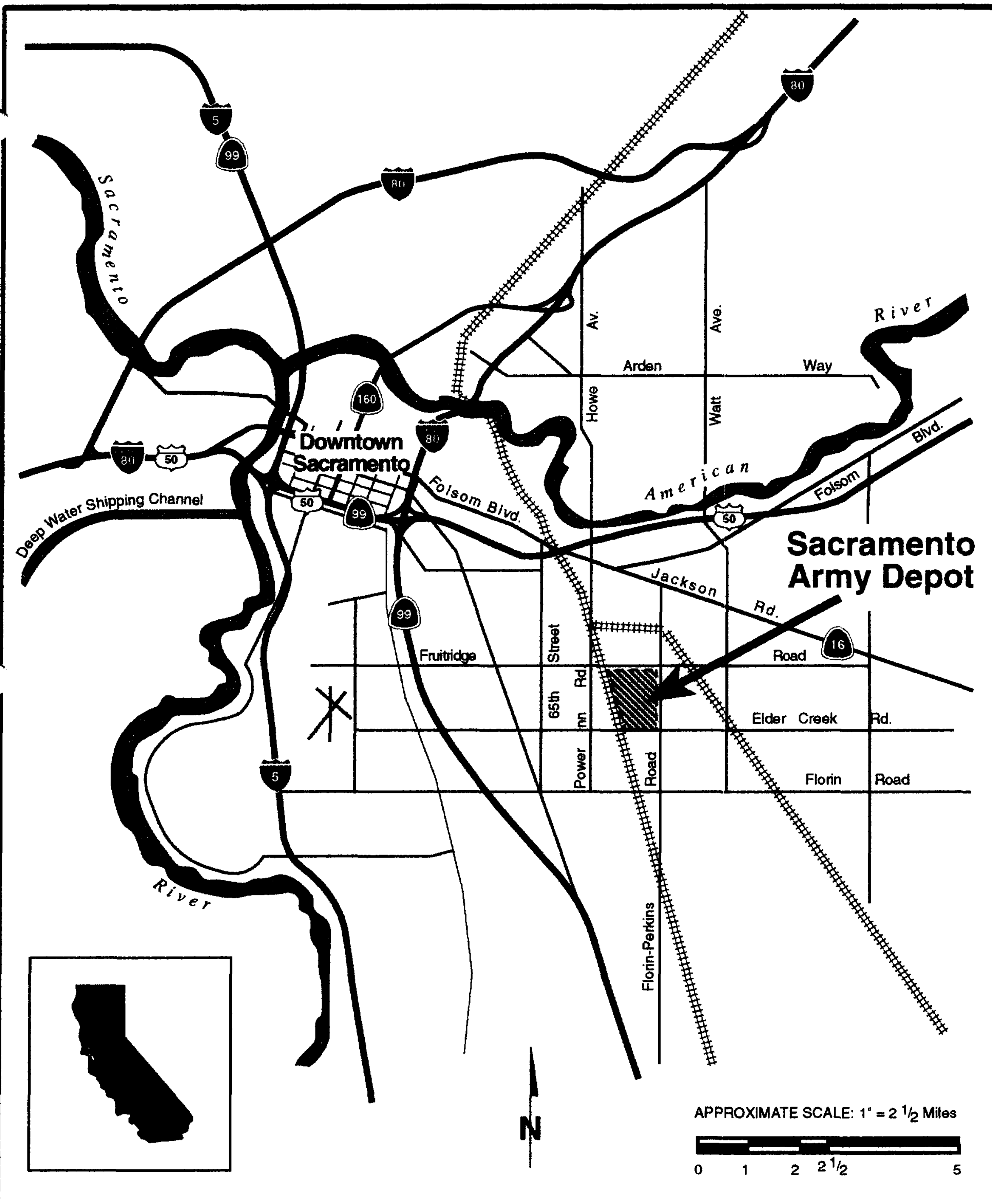
1.2 SITE DESCRIPTION

Past activities conducted at SADA included electro-optics equipment repair, the emergency manufacture of parts, shelter repair, metal plating and treatment, and painting. The metal plating and painting operations were the primary on-site waste generating activities.

Past disposal and storage areas and structures at the site included several underground and above-ground storage tanks, burn pits, unlined wastewater lagoons, a battery disposal area, and areas where pesticides were mixed or pesticide rinse water may have been discharged to the ground surface. Several of these areas have released contaminants into the soil and/or groundwater at SADA, and have been investigated and cleaned up as separate Operable Units. Areas where contaminants have been found at SADA are discussed in more detail in Section 2.

1.3 DEMOGRAPHY

Based on the 1990 census data, the total estimated population in the census tracts within a two mile radius of SADA, including tracts that are partially within the radius, is 64,152. The closest off-depot businesses to contaminated areas at SADA are located across the railroad tracks approximately 800 feet west of the Oxidation Lagoons and the South Post Burn Pits. The closest off-depot resident to contaminated areas at SADA is a residence located on Elder Creek Road approximately 1,800 feet Southwest of the South Post Burn Pits.



KLEINFELDER

DATE PRODUCED: 11/16/92 | DATE REVISED:

PROJECT NO. 24-150029-A51

SITE VICINITY MAP

SACRAMENTO ARMY DEPOT

PLATE

1

1.4 LAND USE

SADA is surrounded on all sides by land currently zoned as commercial/light industrial property. Within 2 to 3 miles of SADA, the areas that are primarily low to medium density residential are northwest, west, and southwest of the site. The areas south, east, and north of the SADA are primarily industrial.

1.5 CLIMATOLOGY

Climate at SADA is classified as "Mediterranean", hot summer (Koppen system), with mean temperatures of 30 to 40 degrees Fahrenheit in January, and 90 to 100 degrees in July. Average relative humidity in January ranges from 80 to 90 percent, and from 50 to 70 percent in July (National Oceanic and Atmospheric Administration, 1985). Generally, 85 to 95 percent of the annual precipitation occurs in winter, and the majority of the evaporation occurs in the summer. The estimated mean annual precipitation at the site is 17 inches, and the estimated mean evaporation is 73 inches.

1.6 REGIONAL TOPOGRAPHY

SADA is located in the Central Valley of California, a broad, flat valley that lies between the Sierra Nevada to the east and the Coast Ranges to the west. The youngest sediments (as old as 5 million years) underlying SADA were deposited by the American River as its course meandered across the valley floor, and, to a lesser extent, by Morrison Creek. Consequently, the topography at SADA is relatively flat. The slope of the land surface is approximately 0.13 percent to the west, with ground surface elevations ranging from 36 to 42 feet above mean sea level.

1.7 SURFACE WATER HYDROLOGY

SADA is situated within the Morrison Creek drainage basin. Morrison Creek originally flowed from east to west through the land now occupied by the SADA facility. When SADA was constructed, the Army re-routed Morrison Creek so that it flowed along the facility boundary around the south side of the facility, rather than through it. The floodplain for the re-routed Morrison Creek extended approximately half a mile north of the creek, onto the SADA facility. The creek ultimately discharges into the Sacramento River.

In 1958, 7,900 linear feet of flood-control dikes were constructed along the re-routed portion of Morrison Creek, and in 1986, the new channel was widened and deepened. The re-routed portion of Morrison Creek is currently capable of handling 100-year flood events, so the contaminated areas are not considered to be on the Morrison Creek floodplain at this time. However, portions of the depot lie within the American River floodplain. The old channel of Morrison Creek receives local runoff only and is dry during most of the year. This channel bisects the facility from east to west and is referred to as "Old Morrison Creek".

Drainage of the SADA facility is mainly overland flow to Morrison Creek and man-made diversion structures. Morrison Creek also receives surface runoff from other industrial and agricultural sites which are located along its course, and permitted discharges from industries.

One wetland area at the facility is located within the Oxidation Lagoons Operable Unit, along Old Morrison Creek, approximately 800 feet north of the Burn Pits. This small area (0.52 acres) has been evaluated by the Army Corps of Engineers, and they have determined that remedial actions in the vicinity will result in minimal adverse impacts and are authorized under the Section 404 Nationwide Permit Program (33CFR Part 330, Appendix A, Numbers 26 and 38).

1.8 GEOLOGY

SADA is located in the Great Valley of California, a broad asymmetric trough filled with a thick assemblage of flat-lying marine and non-marine sediments. The most recent formations deposited in the Great Valley are non-marine sediments derived from the Sierra Nevada foothills and mountains on the west side of the valley and from the Coast Ranges on the east side of the valley. The sediments are carried out of the mountains and deposited by a series of large and small rivers. Sediments under SADA have been largely derived from the Sierra Nevada, and have been deposited by the American River as it has meandered across the valley floor.

The upper 250 feet of sediments under SADA are comprised of interbedded sands, silts, and clays, with some coarse gravels underlying the north side of the facility at an approximate depth of 40 feet. The identification of horizontal and vertical boundaries of geologic formations is extremely difficult in alluvial deposits, such as those underlying SADA. Older buried stream channels exist at various locations and depths in the area. These streams have deposited materials ranging in size from gravel to clay as they meandered across the area. Multiple discontinuous hardpans (cemented clays), representing ancient soil horizons, exist throughout the site.

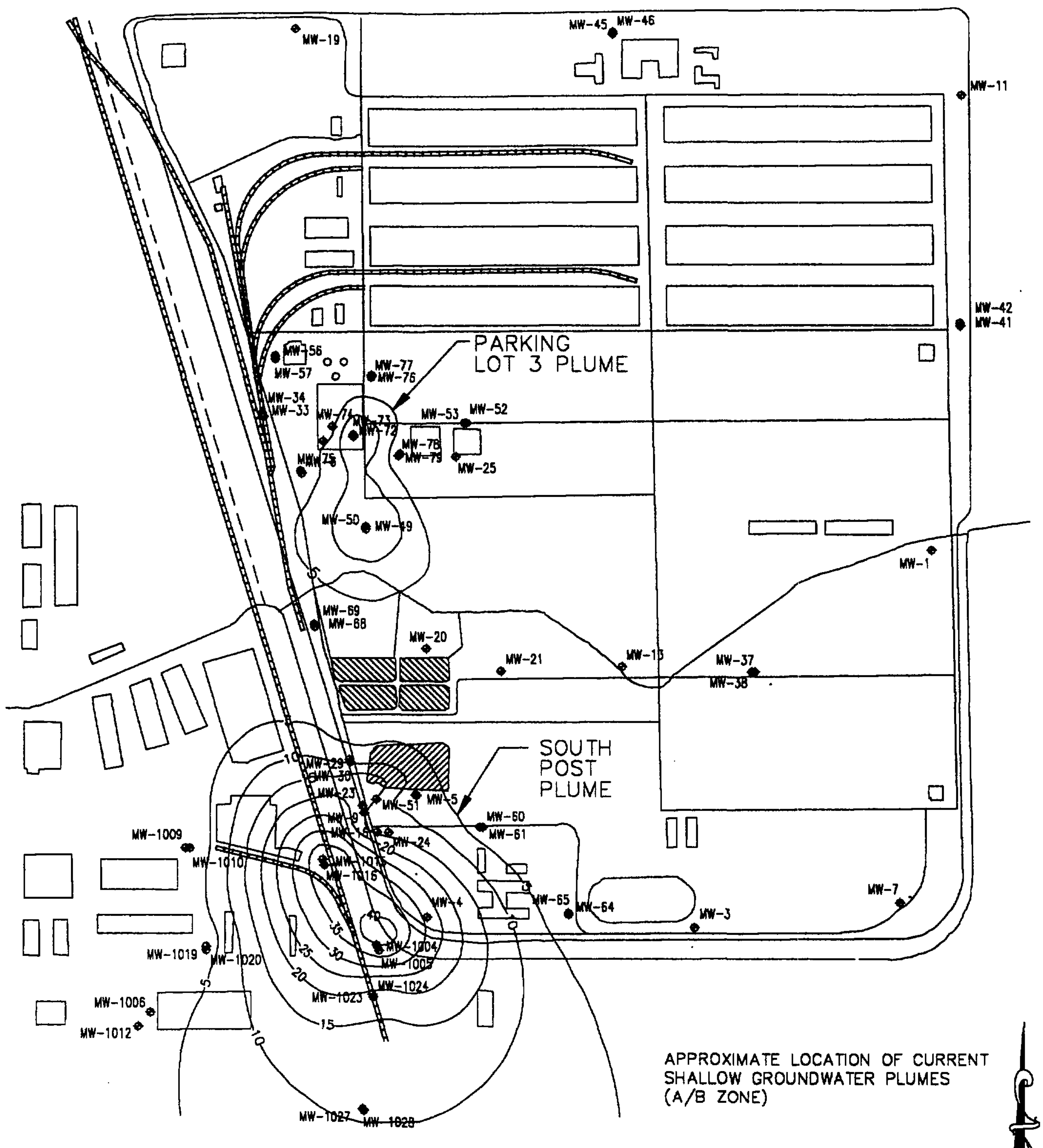
1.9 HYDROGEOLOGY

SADA is underlain by a series of alluvial aquifers which provide water to residences, industries, and agricultural properties in Sacramento County. The California Department of Water Resources has divided the water-bearing sediments in the area into two hydraulically isolated sections: the superadjacent (upper) series, at depths of about 80 to 250 feet beneath the site; and, the subjacent (lower) series, at depths below about 250 feet. The primary water-producing aquifers are in the lower series, although many wells in the area surrounding the site draw water from the upper series.

Groundwater contamination extends off site to the southwest of the SADA facility. The lateral extent of groundwater contamination has been investigated, and appears to extend approximately 1,000 feet southwest of SADA, as shown on Plate 2 for trichloroethene (TCE), the most widespread volatile organic contaminant at SADA. Groundwater monitoring data indicate that VOC contamination extends into the A/B and C aquifer zones. Industries and residences in this area use Sacramento City water from municipal wells located at least three quarters of a mile from SADA. However, there are some private wells in the area of contamination using groundwater exclusively for fire suppression.

1.10 NATURAL RESOURCES

Except for groundwater, which is an extremely important resource throughout the Central Valley, no other natural resources on the site are used.



LEGEND

MW-1 MONITORING WELL LOCATION

5 µg/L TCE ISOCONCENTRATION CONTOURS
(CONTOUR INTERVAL = 5.0 µg/L)

GRAPHIC SCALE
0 100 200 400 800
(IN FEET)
1 inch = 800 ft.

KLEINFELDER

DRAWN BY: B. Walker	DATE: 12-29-94	A/B-ZONE TCE ISOCONTOUR PLOT	PLATE
PROJECT No. 24-150029-A51	DWG No. 0100-002	SACRAMENTO ARMY DEPOT	2

2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

The site investigations conducted at SADA are a part of the U.S Army Installation Restoration Program (IRP). The Army owns the site and is the lead agency for implementing the environmental response actions. In the late 1970's, the U.S. Army Depot Systems Command recommended that SADA be included in the IRP. Consequently, in 1978 and 1979, the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA), now known as the Army Environmental Center (AEC), conducted a review of historical data to assess areas of potential contamination at SADA with regard to the use, storage, treatment, and disposal of toxic and hazardous materials. USATHAMA identified several areas of concern where further investigations were warranted.

In early 1981, the Army initiated an on-site investigation of soil and groundwater in the areas of concern identified by the USATHAMA, including the South Post Burn Pits, Oxidation Lagoons, Pesticide Mix Area, Morrison Creek, and Old Morrison Creek. Groundwater samples collected during this investigation indicated that volatile organic chemicals (VOCs) were present in groundwater under the southwest corner of SADA. Based on the location of the VOCs in groundwater, the South Post Burn Pits were identified as the source of groundwater contamination in this area.

In late 1981, the Central Valley Regional Water Quality Control Board (CVRWQCB) sampled off-site wells near the southwest corner of SADA. VOCs were reported in some of the wells closest to SADA, and the Army began working with the CVRWQCB to assess the source and extent of groundwater contamination. The EPA and the California Department of Health Services (now known as the Department of Toxic Substances Control of the California Environmental Protection Agency) subsequently became involved in the investigation of contamination at SADA, and SADA was placed on the National Priorities List (NPL), effective August 21, 1987 (52 Fed. Reg. 27620; July 22, 1987).

In December 1988, the Army, the EPA, and the State of California signed a Federal Facility Agreement (FFA) under CERCLA Section 120, in which the Army agreed to address the entire facility, including the contaminated groundwater and several areas of suspected soil contamination. The Army assumed responsibility for implementing Interim Remedial Actions and conducting a Remedial Investigation (RI) and Feasibility Study (FS) at SADA. At total of fifty-one sites were initially identified as areas of potential contamination. Eight areas believed to have the greatest potential for releases to the environment were given priority for investigation: South Post Groundwater, Tank 2, Oxidation Lagoons, South Post Burn Pits, Building 300 Burn Pits, Firefighter Training Area, Pesticide Mix Area, and Battery Disposal Well. In order to expedite investigation and cleanup, four of those areas were addressed as Operable Units: South Post Groundwater, Tank 2, Oxidation Lagoons, and South Post Burn Pits. Site locations are shown on Plate 3. Records of Decision (ROD) were signed for each of these Operable Units, as discussed below.

2.1 AREAS ADDRESSED BY OPERABLE UNIT RECORDS OF DECISION

2.1.1 South Post Groundwater

The South Post groundwater was the first area to begin cleanup under an interim ROD signed in 1989. The interim ROD addressed containment and cleanup of on-base groundwater contamination in the southwest corner of the depot. The groundwater in this area is being extracted, treated with UV light/chemical oxidation in a on-base treatment plant, and discharged to the Sacramento Regional Wastewater Treatment System.

Subsequent investigation of the South Post groundwater plume revealed off-base contamination of the aquifer. Consequently, the Army is expanding the remedy to include off-base contamination. Section 5 discusses the expanded site investigation conducted in this area and Sections 7 and 8 discuss additional remedial alternatives for off-base cleanup.

2.1.2 Tank 2

The ROD for cleanup of contaminated soil at the Tank 2 Operable Unit was signed in December 1991. This area was remediated using soil ventilation to clean the soil in place without excavation. The remedy has been completed, cleanup goals have been met and approved by the agencies, and this area requires no further action.

2.1.3 Oxidation Lagoons

The ROD for the Oxidation Lagoons was signed in September 1992. The remedy selected to clean up the soil was excavation of contaminated soil, followed by on-site soil washing to remove metals of concern, and placement of clean, washed soil back into the excavation. A large scale pilot test for soil washing was conducted at the area in 1993. The pilot test indicated that soil washing did not offer the most cost effective technology for protection of human health and the environment. Consequently, the Army has re-evaluated the remedy for the Oxidation Lagoons and is amending the OU ROD to change the remedy from soil washing to soil stabilization. This amendment is discussed in detail in Section 9.5.

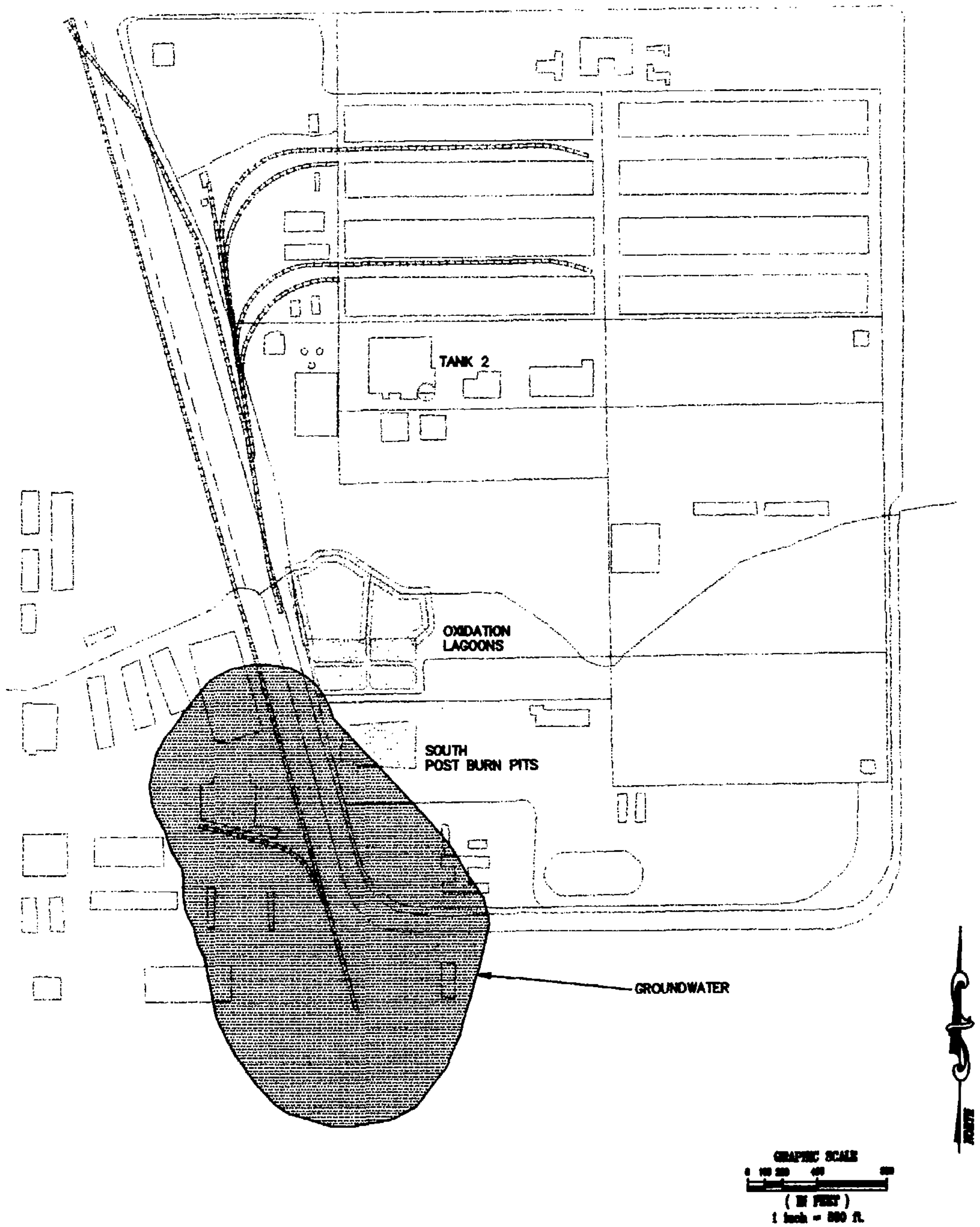
2.1.4 South Post Burn Pits

The ROD for cleanup of soil contamination at the South Post Burn Pits was signed in 1993. The remedy selected was in situ soil ventilation to remove volatile organic contaminants, followed by excavation of the pit area with stabilization of the excavated soil to treat non-volatile compounds, and backfill of the pits with the stabilized soil.

In this basewide ROD, the Army is amending both phases of the previously selected remedy specified in the South Post Burn Pits OU-ROD. This amendment is discussed in detail in Section 9.4.

2.2 ADDITIONAL AREAS ADDRESSED UNDER THIS SITEWIDE RECORD OF DECISION

The FFA called for a RCRA Facility Assessment (RFA) to identify other specific Solid Waste Management Units (SWMUs) that need further characterization and cleanup. Thirteen additional areas were evaluated under the RFA process, which included a historical records review, visual site inspection, and sampling. In addition, the Army evaluated twenty nine areas not suspected as SWMUs by conducting reviews of historical aerial photographs and records. Based on investigation results, each area is addressed in the basewide RI/FS, and in this Record of Decision, as either 1) requiring remedial action or 2) no action/no further action. Locations of areas requiring remedial action are shown on Plate 4 (South Post groundwater is shown on Plate 3), and no action areas are shown on Plate 5. The identification and categorization of these areas are discussed in more detail in Section 4.



SITE NAME	SITE NUMBER	CONTAMINANTS OF CONCERN
TANK 2	005	VOLATILE ORGANIC COMPOUNDS
OXIDATION LAGOONS	001	METALS
SOUTH POST BURN PITS	002	VOLATILE ORGANIC COMPOUNDS, METALS
SOUTH POST GROUNDWATER		VOLATILE ORGANIC COMPOUNDS

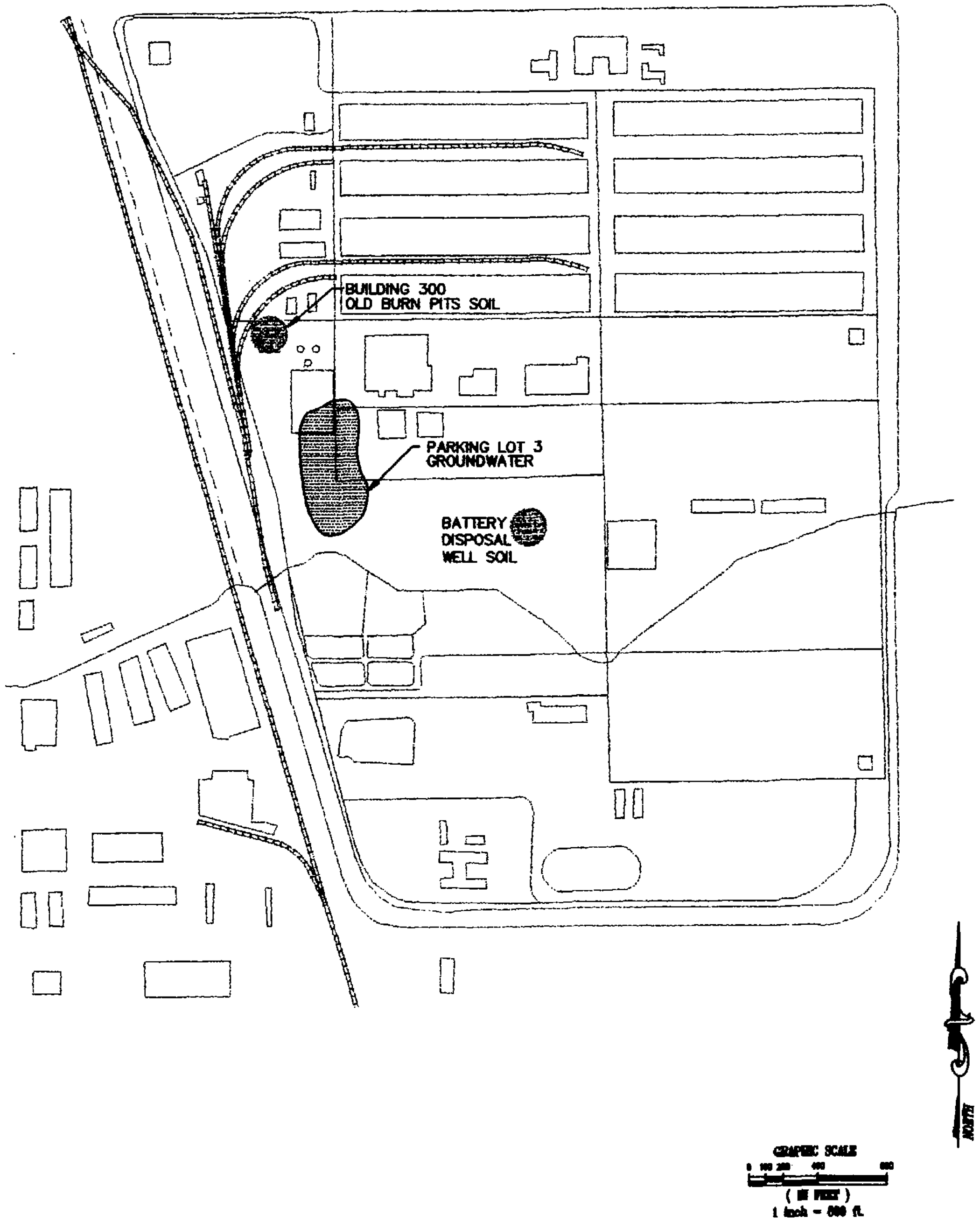
LEGEND

APPROXIMATE AREA OF GROUNDWATER CONTAMINATION

APPROXIMATE AREA OF SOIL CONTAMINATION

NOTE: This plate is intended to show the general area location of each site and not the extent of contamination.

KLEINFELDER		AREAS ADDRESSED BY OPERABLE UNITS RODS	PLATE 3
DRAWN BY: L. DANG	DATE: 2-28-95	SACRAMENTO ARMY DEPOT	
PROJECT No. 24-150035-H05	DWG No. SA301-3		



SITE NAME	SITE NUMBER	CONTAMINANTS OF CONCERN
BUILDING 300 OLD BURN PITS	007	METALS
PARKING LOT 3 GROUNDWATER		VOLATILE ORGANIC COMPOUNDS
BATTERY DISPOSAL WELL	009	METALS

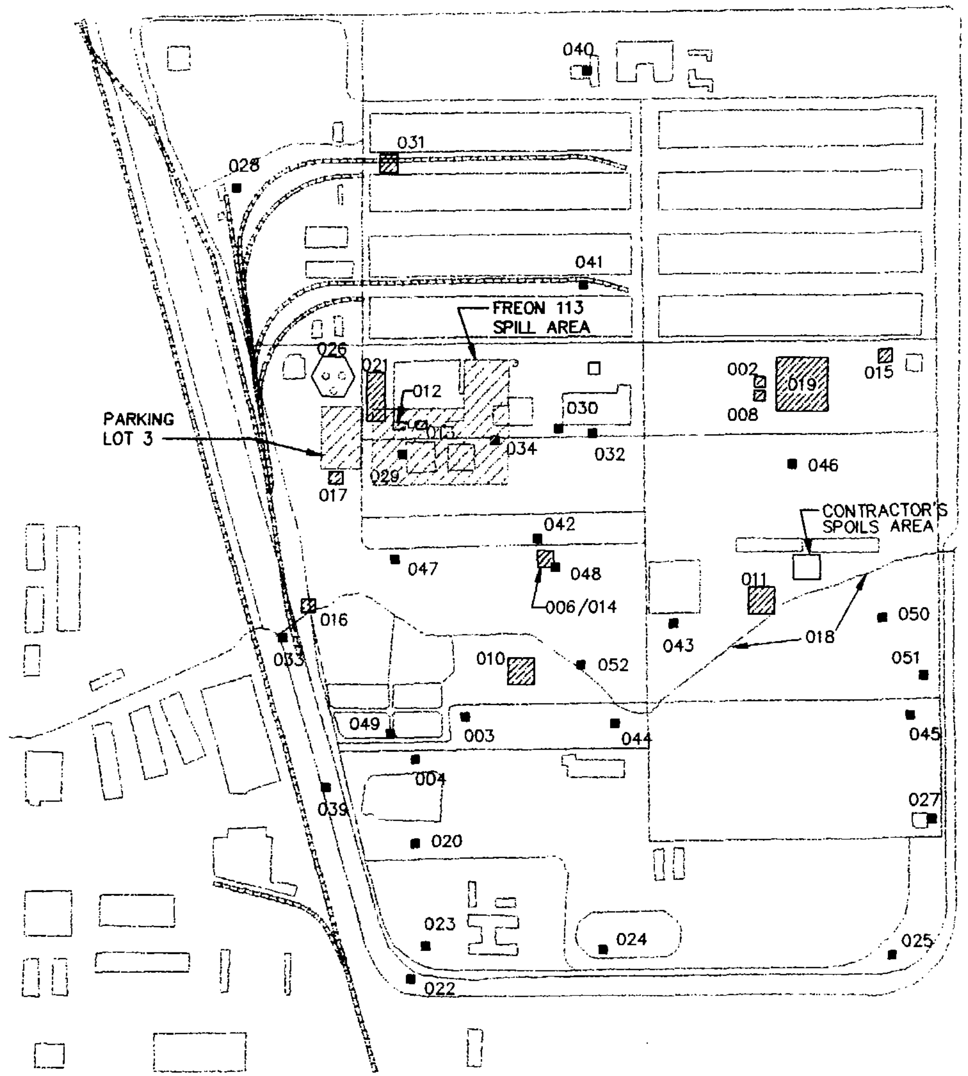
LEGEND

AREAS TO BE REMEDIATED

AREAS TO BE REMEDIATED

NOTE: This plate is intended to show the general area location of each site and not the extent of contamination.

KLEINFELDER		AREAS REQUIRING REMEDIAL ACTION	PLATE
DRAWN BY: L. DANG	DATE: 2-28	SACRAMENTO ARMY DEPOT	4
PROJECT No. 24-150035-H05	DWG No. SA302-4		



SITE NAMES	SITE NUMBER
Small Shallow Lagoon (Mid 1960's – early 1970's)	SITE–003
Sludge Piles, South of Oxidation Lagoons	SITE–004
Firefighter Training Area	SITE–006
Pesticide Mix Area	SITE–008
Possible Trenches	SITE–010
Two Trenches	SITE–011
Building 315 – Cyanide Sump	SITE–012
Building 316 – Acid Sump	SITE–013
Possible Shallow Lagoon	SITE–014
Building 382 (gasoline spills)	SITE–015
Paint, Residue and Waste Oil Dump	SITE–016
Outdoor Storage of Wastes	SITE–017
Old Morrison Creek (east portion)	SITE–018
Fill Area with Numerous Vehicles	SITE–019
Trash Disposal Areas	SITE–020
Cyanide Leach Field	SITE–021
Radioactive Waste Disposal Area	SITE–022
Dispensary Waste Area	SITE–023
Petroleum, Sludge Disposal Area	SITE–024
Previous Oil Dump	SITE–025
Former Secondary Sewage Treatment Plant	SITE–026
AAFES Drain Well	SITE–027
Rail Yard Engine Shed	SITE–028
Building 420 (chromic acid spill)	SITE–029
1,000 – Gallon Waste Solvent Tank No. 3	SITE–030
5,000 Gallon Waste Solvent Tank No.1	SITE–031
500 – Gallon Battery Acid Storage Tank No. 4	SITE–032
Sewage Outfall Area	SITE–033
Building 320 (plating spill)	SITE–034
Morrison Creek	SITE–039
Possible Open Storage Area (1947–50)	SITE–040
Possible Open Storage Area (1947–50)	SITE–041
Probable Drum Storage Area (1947–50)	SITE–042
Possible Open Storage Area (1947–50)	SITE–043
Depressed Disturbed Area, Possible Dump Site (1948–50)	SITE–044
Large Disturbed Area (1947–50)	SITE–045
Possible Trench (early 1950's)	SITE–046
Large Scarred Area, Possible Fill Activity (1950's)	SITE–047
Possible Dump Site (early 1950's)	SITE–048
Possible Fill Material (late 1950's – early 1970's)	SITE–049
Excavation Activity with Piles of Removed Soil (1960's)	SITE–050
Standing Liquid (1960's)	SITE–051
Scarred/Stressed Area (mid – 1960's)	SITE–052
Contractor's Storage Area	SITE–054

GRAPHIC SCALE
(IN FEET)
1 inch = 800 ft.

NORTH

LEGEND

011 ▨ / 025 ■ APPROXIMATE SITE LOCATION AND SITE NUMBER

NOTE: This plate is intended to show the general area location of each site and not the actual dimensions of each site.

KLEINFELDER		NO ACTION/NO FURTHER ACTION SITES SACRAMENTO ARMY DEPOT	PLATE 5
DRAWN BY: LD PROJECT No. 24–150035–H05	DATE: 12–16–94 DWG No. 35H05B05		

3 HIGHLIGHTS OF COMMUNITY PARTICIPATION

The Army has encouraged public involvement throughout the RI/FS process. Public comment periods and public meetings have been held in connection with each Operable Unit ROD and with this Basewide ROD, and fact sheets have been mailed to the public at various times throughout the investigation.

In June 1994, the Army established a Restoration Advisory Board (RAB) to increase public participation by involving the community in the decision-making process. The RAB consists of members from the community and representatives from the Army, the U.S. Environmental Protection Agency, and state regulatory agencies. The RAB functions as an advisory body to provide input on activities that will assist in the cleanup and conversion of the base for reuse by the community.

In June 1994, the Army mailed a fact sheet to the public which described alternatives for basewide soil cleanup at SADA. A public comment period was held June 8 through July 7, 1994 and a public meeting was held on June 16, 1994. At the meeting, the Army discussed potential alternatives for basewide soil cleanup. The Army explained the concept of establishing a Corrective Action Management Unit (CAMU) at the South Post Burn Pits to increase the reliability, protectiveness, and effectiveness of the cleanup remedy and reduce its cost.

The Basewide RI and FS reports and the Proposed Plan for the Sacramento Army Depot were released to the public in November 1994. These documents were placed in the Administrative Record and the information repositories maintained at the Sacramento State University Library (third floor, in the Science and Technology Department), the Sacramento Army Depot Security Center (8350 Fruitridge Road), and the George Sim Community Center (6207 Logan St.). Due to limited space, the George Sim Community Center contains only current documents for review and comment. The RI, FS, and Proposed Plans are also available for review at the Regional office of the Department of Toxic Substances Control (DTSC) and U.S. EPA Region IX in San Francisco. The notice of availability of these documents and the announcement of the start of the public comment period and the public meetings were published in the Sacramento Bee Newspaper, Metro Section on three occasions, November 23, 27 and December 4, 1994.

A public comment period was held from November 22, 1994 through December 21, 1994. In addition, a public meeting was held on December 7, 1994. Representatives from the depot, EPA and state agencies discussed conditions at the site and presented the basewide remedial alternatives under consideration. Approximately 45 people, including community members and representatives from the Army, U.S. EPA, and Cal-EPA (DTSC and RWQCB) were in attendance. The meeting was held at George Sim Community Center, which is centrally located within the affected community. Oral comments received at the meeting are summarized in the Responsiveness Summary, which is Part III of this Basewide ROD.

This decision document presents the selected remedial action for the Sacramento Army Depot in Sacramento, California, chosen in accordance with CERCLA, as amended by SARA, and to the extent practicable, the National Contingency Plan. The decision for this site is supported by documentation in the Administrative Record.

4 SCOPE AND ROLE OF THE RESPONSE ACTION

This document is the final basewide Record of Decision for SADA. The scope encompasses the entire site by reviewing those areas previously addressed as operable unit RODs (including ROD amendments presented in this document), by identifying those areas where remedial action is required, and by identifying those areas for which no remedial action is required either because 1) no contamination was found, 2) previous actions have sufficiently mitigated the threat so that there remains no significant threat to human health or the environment, or 3) CERCLA does not provide legal authority to undertake a remedial action because releases involving petroleum only are exempt under CERCLA Section 101.

For ease of discussion, all areas were classified in one of the following three categories:

1. Areas previously addressed as Operable Units
2. Areas requiring remedial action
3. Areas requiring no action or no further action

Addressed as Operable Units	Requires Remedial Action	No Action/Further Action
South Post Groundwater[1] Tank 2	Parking Lot 3 Groundwater Battery Disposal Well Investigation-Derived Waste	Pesticide Mix Area Firefighter Training Area
South Post Burn Pits Soil[2]	Building 300 Burn Pits Soil	SWMU and Non-SWMU Sites
Oxidation Lagoons[3]	South Post Groundwater	Parking Lot 3 Soil
		Freon 113 Area
		Contractor's Spoils Area

This classification system will be referenced throughout the ROD. Additional details on these areas are provided in Section 5 of this ROD. Table 1 in Section 5 provides a summary of site characteristics and investigation activities for each area.

[1] The South Post Groundwater was originally addressed as an operable unit for cleanup of on-depot contamination. However, as a result of additional investigation of the extent of contamination, the area has been recategorized as "requiring remedial action" to address off-base contamination.
[2] The South Post Burn Pits ROD is being amended.
[3] The Oxidation Lagoons ROD is being amended.

5 SUMMARY OF SITE CHARACTERIZATION

5.1 AREAS REQUIRING REMEDIATION

Extensive investigations conducted at SADA have revealed contamination in both the soil and groundwater, particularly in the southwest corner. A summary of the areas investigated is provided in Table 1. Areas where soil contamination was discovered are most likely the result of waste disposal/treatment or chemical spills that occurred during past activities conducted at the depot. Areas where contaminated groundwater was encountered appear to be the direct result of contaminant transport from the overlying contaminant-laden soil areas.

5.1.1 Parking Lot 3 Groundwater

Four volatile organic compounds (VOCs) have been detected above the federal or more stringent state drinking water Maximum Contaminant Level (MCL) in the Parking Lot 3 groundwater, and are contaminants of concern. In addition, chromium has been detected at levels above the MCL in one monitoring well, but is not currently listed as a contaminant of concern.

5.1.1.1 VOCs

Carbon tetrachloride, trichloroethene (TCE), tetrachloroethene (PCE), and 1,2-dichloroethane (DCA) have been consistently detected above the MCL in the groundwater at Parking Lot 3. The most recent sampling indicates this is still the case in select wells. Carbon tetrachloride was detected above the MCL in three monitoring wells (MW-50, 77, and 75) with the highest detection occurring in MW-75 at 1.3 ug/l (MCL: 0.05 ug/l). TCE was detected above the MCL in two wells (MW-50 and 75) with the highest concentration in MW-73 at 38 ug/l (MCL: 5 ug/l). PCE was detected in MW-75 at 37 ug/l (MCL: 5 ug/l). This was the only monitoring well with PCE above the MCL. Similarly, DCA was detected above the MCL exclusively in MW-75 at 4.2 ug/l (MCL: 0.05 ug/l). Monitoring well location at SADA are shown on Plate 6.

5.1.1.2 Chromium

Chromium has been detected in the Parking Lot 3 area over the past year at levels above the MCL of 50 ug/l in MW-74. Chromium also has been detected periodically above statistically estimated background concentrations, but below the MCL, in other monitoring wells. Therefore,

TABLE 1
SITE SUMMARIES

Site Name	Site Characteristics	Date of Operation	Summary of Site Investigations	Contaminants of Concern	Status
AREAS ADDRESSED BY OPERABLE UNIT RODs					
Groundwater	On-base and off-base contamination by volatile organic chemicals (VOCs) in southwest area of SADA.	N/A	Monitoring of A/B, C and D aquifers since 1989. On-base and off-base wells are sampled. Samples have been analyzed for volatile organic chemicals (VOCs), metals, minerals and pesticides. Contamination is primarily in A/B aquifer.	Chloroform, carbon tetrachloride, trichloroethene, tetrachloroethene, 1,2-dichloroethene, 1,2-dichloroethane.	Extraction using 7 vertical wells and treatment using hydrogen peroxide/ultraviolet method is ongoing. An interim ROD for on-base groundwater was signed in 1989. The Army will expand the remedy to address the entire plume.
Oxidation Lagoons (and west portion of Old Morrison Creek)	Waste holding ponds used for the disposal of plating shop wastes containing heavy metals.	1950-1972	Soil samples collected from each lagoon, drainage ditches, and Old Morrison Creek. Samples analyzed for metals. Contamination restricted to top 2-3 feet of soil.	Arsenic, cadmium, lead	The ROD was signed in 1992. Contract was awarded and pilot scale soil washing test was conducted. The basewide ROD includes an amendment to the Oxidation Lagoons ROD, which would select a different remedy.
South Post Burn Pits	Two pits used to bury and burn a variety of material such as plating shop wastes, paint sludge, mercury batteries, construction debris, and waste from Building 300 Old Burn Pits.	1950's - 1966	Soil samples collected from surface to 85 feet. Samples analyzed for VOCs, semi-VOCs, metals, polychlorinated biphenyls (PCBs), dioxins, furans. VOC contamination extends to groundwater. Other contaminants confined to the pits (surface to 20 ft. below surface).	Arsenic, cadmium, chromium, lead, 1,2-dichloroethene, tetrachloroethene, trichloroethene	The ROD was signed in March 1993. Remediation of volatile organics by soil venting is in progress. Soil stabilization will follow. The basewide ROD includes an amendment to the Burn Pits ROD, which would expand the scope of the stabilization to include soil from B.300, Battery Disposal Well, and Oxidation Lagoons, and would select a different cleanup standard.
Tank 2	Soil contaminated by waste solvents from Tank 2.	Mid-late 1970's	Soil samples collected to 50 feet below surface . Samples analyzed for VOCs, semi-VOCs, organochlorine pesticides & PCBs. Contamination detected to 30 feet below surface.	2-butanone, ethylbenzene, xylenes, tetrachloroethene	The ROD was signed in 1991. Site has achieved cleanup standards using soil vapor extraction and is capped with concrete. "No further action" is required.
AREAS REQUIRING REMEDIAL ACTION					
Building 300 Old Burn Pits	Two pits used for the disposal of plating shop wastes, paint sludge, acids, radium dial paint, and mercury batteries	1945-1950's	Soil samples collected from surface to 80 feet below surface. Samples analyzed for organochlorine/organophosphate pesticides, PCBs, VOCs, semi-VOCs, metals, dioxins, furans, radium 226/228.	Polychlorinated biphenyls, arsenic, cadmium, lead	Remedial alternatives are discussed in this ROD.
Battery Disposal Well	Area used for the disposal of dry cell batteries and other industrial debris.	1950's - 1960's	Soil and debris excavated to 30 feet below surface. Soil samples analyzed for VOCs, semi-VOCs, metals. Debris and contaminated soil were excavated during site investigation in April, 1993.	Cadmium, copper, lead, mercury, silver, zinc.	Excavated soil (investigation derived waste), stored in bins. Remedial alternatives for IDW soil are discussed in this ROD. Excavation has been backfilled with clean soil.

TABLE 1
SITE SUMMARIES

Site Name	Site Characteristics	Date of Operation	Summary of Site Investigations	Contaminants of Concern	Status
Parking Lot 3 Groundwater	Zone A/B plume extending under and south of Parking Lot 3.	N/A	Multiple monitoring wells installed and sampled since early 1992. BAT Probe investigations. Two pilot wells and two pump tests.	TCE up to 16 ug/l. PCE up to 37 ug/l. Carbon tetrachloride and 1,2-DCA also exceed FRGs. Chromium is detected and is a potential contaminant of concern.	Remediation required. Alternatives discussed in this ROD.
NO ACTION/NO FURTHER ACTION AREAS					
Firefighter Training Area	Area reportedly used for Depot firefighter training purposes. Gasoline and JP4 ignited and burned in a pit.	1958-1963	Nine soil borings drilled. Samples collected from surface to 21 feet below surface and analyzed for VOCs, semi-VOCs, metals, organochlorine pesticides, PCBs, total petroleum hydrocarbons (TPH), dioxins, and furans.	None	Reported site location was investigated and no contamination was found. "No action" proposed.
Pesticide Mix Area	Area used for the rinsing of pesticide containers. Rinse water was allowed to flow onto the open ground and seep into the soil.	? - 1981	Soil samples collected to 89 feet below surface. Samples analyzed for PCBs, VOCs, TPH, organochlorine/organo-phosphate pesticides. Contamination mainly in top 3-4 feet. Contaminated soil excavated during removal of drain well in April 1993.	4,4'-DDT, 4,4'-DDE, 4,4'-DDD, Prometon, chlordane	Investigation - derived waste disposed in Class I landfill. Excavation has been backfilled with clean soil. The area presents no threat to human health or the environment. "No further action" proposed.
Possible Trenches	Two parallel trenches indicated from a 1957 aerial photo. Not visible in a 1961 aerial photo.	1957-1961	8 borings were drilled to 21.5 feet below surface. Soil samples were collected from 1.5, 6, 11, 16, and 21 feet below surface. Samples were analyzed for VOCs, semi-VOCs, metals.	None.	Metals are reported at background levels. "No action" proposed.
Two Trenches	Site consists of a north/south trench and an east/west trench. This site is located adjacent to the Contractor's Spoils Area and Old Morrison Creek.	1966-1968	8 borings drilled to 21.5 feet below surface. Samples collected at 1.5, 6, 11, 16, and 21 feet below surface. Samples analyzed for VOCs, semi-VOCs, metals. VOCs detected.	1,1,1-trichloroethane (25 ug/kg) tetrachloroethene (5.1 ug/kg) Xylenes (10 ug/kg)	Metals are at background levels. Risk assessment for VOCs indicates no threat to human health or the environment. "No action" proposed.
Building 315 (Cyanide Sump)	Reportedly a 12,000 gallon sump used to hold waste containing cyanide, cadmium and zinc prior to transfer to the purported cyanide leach field.	1954-1956	4 borings drilled to 11.5 feet below surface. Samples collected at 1, 6, 11 feet below surface. Samples analyzed for VOCs, semi-VOCs, metals, cyanide.	None.	Metals reported at background levels. The sump was covered by 8-12 inches of concrete. It has been opened up, cleaned out, and backfilled with clean fill. No further action proposed.
Building 316 (Acid Sump)	Reportedly a 12,000 gallon sump used to hold acid wastes and metals.	1983-?	3 borings drilled to 10 feet; 1 boring to 8 feet. Samples collected at 1, 5.5, 9.5 feet below surface. Samples analyzed for VOCs, semi-VOCs, metals, cyanide. pH ranged from 7-8.4 except one sample with pH 4.8. Elevated metals detected.	Zinc (148 mg/kg) Cadmium (21.7 mg/kg)	Site was covered by 8-12 inches of concrete. Risk assessment indicates metals present no threat to human health or the environment. The sump has been opened up, cleaned out, and backfilled with clean fill. No further action proposed.

TABLE 1
SITE SUMMARIES

Site Name	Site Characteristics	Date of Operation	Summary of Site Investigations	Contaminants of Concern	Status
Possible Shallow Lagoon	Initially indicated from a 1953 aerial photo as a shallow dry depression. Disposal of wastes at this site has not been documented and no evidence exists as to the use, storage or disposal of hazardous materials.	1953-1957	A soil gas survey was conducted to locate the site. Reported maximum total volatile hydrocarbons of 4 ug/L reported at depth of 0-3.5 feet below surface. Soil borings drilled at site 006 included this area. No contaminants were detected.	None.	This site is located in the same area as site 006. No contaminants were found in this area. "No action" proposed.
Building 382 (gasoline spills)	Reported spills of gasoline and oil near Building 382 and Warehouse 7.	Mid-1960's	4 borings drilled to 11.5 feet below surface. Samples collected at 2, 6, and 11 feet below surface. Samples analyzed for TPH. None detected.	None.	No gasoline or oil found in the samples analyzed. No risk to human health and the environment. "No action" proposed.
Paint, Residue and Waste Oil Dump	Site was reportedly used as a dump for paints, residues and waste oils. Site was indicated based on interviews with depot employees and not on physical evidence or sampling.	1946	A shallow soil gas survey was conducted to locate the site. Report maximum total volatile hydrocarbons of 4 ug/L found at depth of 0-3.5 feet below surface. Eight confirmation soil borings were drilled to 16.5 feet below surface. Samples were collected at 5 foot intervals. Samples were analyzed for VOCs, semi-VOCs, pesticides, TPH, and metals.	4,4'-DDE (.085 mg/kg) dieldrin (0.1 mg/kg)	Exact location of the reported site could not be confirmed. Risk assessment indicates pesticide levels in the area present no threat to human health or the environment. "No action" proposed.
Outdoor Storage of Wastes	Site was used for the storage of drummed hazardous waste containing metals.	1950's-1970's	6 borings drilled to 6.5 feet below surface. Samples collected at 1, 3.5, and 6 feet below surface. Samples analyzed for metals. Soil sample from 83 feet below surface analyzed for VOCs.	None.	Metals found at background levels. No VOCs detected. "No action" proposed.
Old Morrison Creek (east portion)	Portion of Old Morrison Creek which flowed through the eastern portion of the Depot based on past aerial photos. Potential contaminants which may have leached into the creek are petroleum wastes, oils and lubricants, and by-products of paint sludges.	1940's - ?	4 borings drilled to 6.5 feet below surface and samples collected at 2, 4, and 6 feet. Samples analyzed for TPH and metals. No TPH detected.	None.	Metals found at background levels. "No action" proposed.
Cyanide Leach Field (Building 320)	Reported leach field from the cyanide sump located east of the site. The leach field was reported to not work due to low permeability of the soil.	1963-1977	In 1990, 9 borings drilled to 4.5-5.5 ft. below surface. Samples collected at 1.5, 4.5 feet below surface. Samples analyzed for metals and cyanide. Cyanide detected at 1.5 and 4.5 feet below surface. In 1993, 1 boring drilled. Samples collected at 26.5, 36.5, 66.5, 76.5 feet below surface. Samples analyzed for VOCs. None detected.	Cyanide (0.78 mg/kg)	Metals are found at background levels. Cyanide level found presents no threat to human health or the environment. Leach field piping has been exposed and sampled for metals and cyanide. Surrounding soil has been sampled. Metals are at background levels. No further action proposed.

TABLE 1
SITE SUMMARIES

Site Name	Site Characteristics	Date of Operation	Summary of Site Investigations	Contaminants of Concern	Status
Fill Area with Numerous Vehicles	The site was reportedly used for open storage of vehicles and equipment, and possibly is contaminated with petroleum hydrocarbons.	1957-1968	1) 4 borings drilled to 11.5 feet below surface. Samples collected at 1.5, 6, and 11 feet. Samples analyzed for VOCs, semi-VOCs, TPH. TPH found in one sample at 6 feet. 2) A shallow soil gas survey was conducted to verify the extent of TPH. No TPH reported. TCE (0.03 ug/L) and PCE (2 ug/L) were found at depth of 1 foot. 3) 2 confirmation borings drilled to 16.5 feet below surface. Samples were collected at 5 foot intervals. Samples analyzed for VOCs, pesticides, TPH. TCE, PCE, BTEX not detected. Pesticides detected.	Total petroleum hydrocarbons (TPH) (140 mg/kg) Trichloroethene, tetrachloroethene 4,4'-DDD (0.041 mg/kg) 4,4'-DDE (0.017 mg/kg) 4,4'-DDT (0.023 mg/kg) dieldrin (0.034 mg/kg) chlordane (0.004 mg/kg) Freon 113 (0.015 mg/kg)	Unknown TPH was an isolated event. Additional investigation did not confirm the presence of TPH. VOCs not detected in confirmation borings. Pesticide levels in the area present no threat to human health or the environment. "No action" proposed.
5000-gallon Hazardous Waste Tank No. 1	Tank No. 1 was an underground storage tank used for the storage of battery acid from the mid 1950's to the late 1970's. Tank was removed in 1986. Site is covered with concrete.	1950's - 1970's	Five borings drilled to 21.5 feet below surface. Samples collected at 4, 6, 11, 16, and 21 feet below surface. Samples analyzed for VOCs, semi-VOCs, organo-chlorine pesticides and PCBs. None detected.	None.	"No action" proposed.
Contractor's Storage Area	Site is located north of Building 348 and has been reportedly used for the storage of construction materials and some waste materials by contractors working at SAAD. The site is covered with grassy vegetation.	1970's - 1980's	6 borings were drilled to 11.5 feet below surface. Samples were collected at 2, 5.5, and 11 feet. Samples were analyzed for VOCs, semi-VOCs, metals. No VOCs, semi-VOCs were detected.	None.	Metals concentrations found at background levels. "No action" proposed.
Small Shallow Lagoon	Topographic low located east of Oxidation Lagoons may have received surface water runoff.	Mid 1960's to early 1970's	1 soil boring drilled in low area. Soil samples analyzed for metals.	None	Metals at background levels. "No action" proposed.
Sludge Piles	Piling south of the Oxidation Lagoons with possible metals contaminated soil.	Late 1950's to late 1960's	In 1994, 3 soil borings drilled. Samples collected at 0, 5, & 10 ft. below surface. Samples analyzed for metals.	None	Metals at background levels. "No action" proposed.
Trash Disposal Areas	Trenches located south of Burn Pits with construction debris.	Early 1950's to mid 1960's	IR survey showed no anomalies. No trenches visible in aerial photos. Sites are located near residential housing for depot commander, and not likely hazardous waste disposal sites.	None	No evidence of hazardous waste disposal at these sites. "No action" proposed.

TABLE 1
SITE SUMMARIES

Site Name	Site Characteristics	Date of Operation	Summary of Site Investigations	Contaminants of Concern	Status
Radioactive Waste Disposal Area	Reported dump area for radioactive material in southwest corner of depot.	Late 1940's	A surface survey to screen for radioactivity has been conducted in suspected area. None detected above background levels. Aerial photo review shows no evidence of trenching or pits. Groundwater analyzed for radium. None detected. Random borings show no evidence of radioactivity.	None	No visual evidence that site existed. Site does not show elevated radioactivity. "No action" proposed.
Dispensary Waste Area	Reported dump area in southwest corner of depot.	1960's	Visual inspection of area and aerial photos show no evidence of the site. Documented waste disposal practices show disposal in Burn Pits or off-base. IR survey conducted. No anomalies found.	None	No indication site ever existed. "No action" proposed.
Petroleum Sludge Disposal Area	Reported dumping of gasoline tank sludge south of the running track.	Late 1950's	Two borings drilled. Samples collected at 0, 5 feet below surface. Analyzed for TPH, lead. No TPH found. Lead at background levels.	None	Sampling found no evidence of contamination. "No action" proposed.
Previous Oil Dump Area	Reported dumping of oil in the southeast corner of depot.	Mid 1960's	Two near surface soil samples collected and analyzed for oil and grease. None detected.	None	No oil or grease found in soil samples. "No action" proposed.
Former Secondary Sewage Treatment Plant	Sewage treatment plant west of Building 320 received wastewater from plating operations.	1940's to 1972	5 borings drilled to 10 feet below surface. 18 samples analyzed for metals.	None	Metals concentrations in soil typical of background. "No action" proposed.
AAFES Drain Well	Surface drain well southeast of Building 699, at the AAFES gasoline station.	Unknown to Present	GPR survey in 1994. Drain well and pipe removed. Samples collected from sides and bottom of excavation and below drain pipe. Samples analyzed for TPH.	None	Soil samples give no evidence of contamination. Drain well has been removed. "No action" proposed.
Rail Yard Engine Shed (Locomotive Repair Area)	Site consists of two buildings used for the maintenance of the Depot's locomotive switch engine.	1940's - present	IR survey reported elevated temperatures beneath concrete pad south of B. 205. Soil samples indicate gasoline and diesel to 10 feet below surface.	Gasoline Diesel	An in-situ bioremediation pilot test is being conducted at this area. The Railyard is not under CERCLA jurisdiction, per CERCLA Section 101, because only petroleum hydrocarbons are present. Area will be cleaned up prior to property transfer.
Building 420 Chromic Acid Spill	B. 420 spilled chromic acid.	1978	Based on interviews, spill occurred in NE corner of building and was contained. Two borings drilled outside buildings to approx. 7 feet below surface. Soil samples analyzed for chromium. Downgradient wells sampled. No evidence of contamination.	None	Chromium was detected at 26 mg/kg, a level typical of background. No chromium in groundwater downgradient of the site. "No action" proposed.

TABLE 1
SITE SUMMARIES

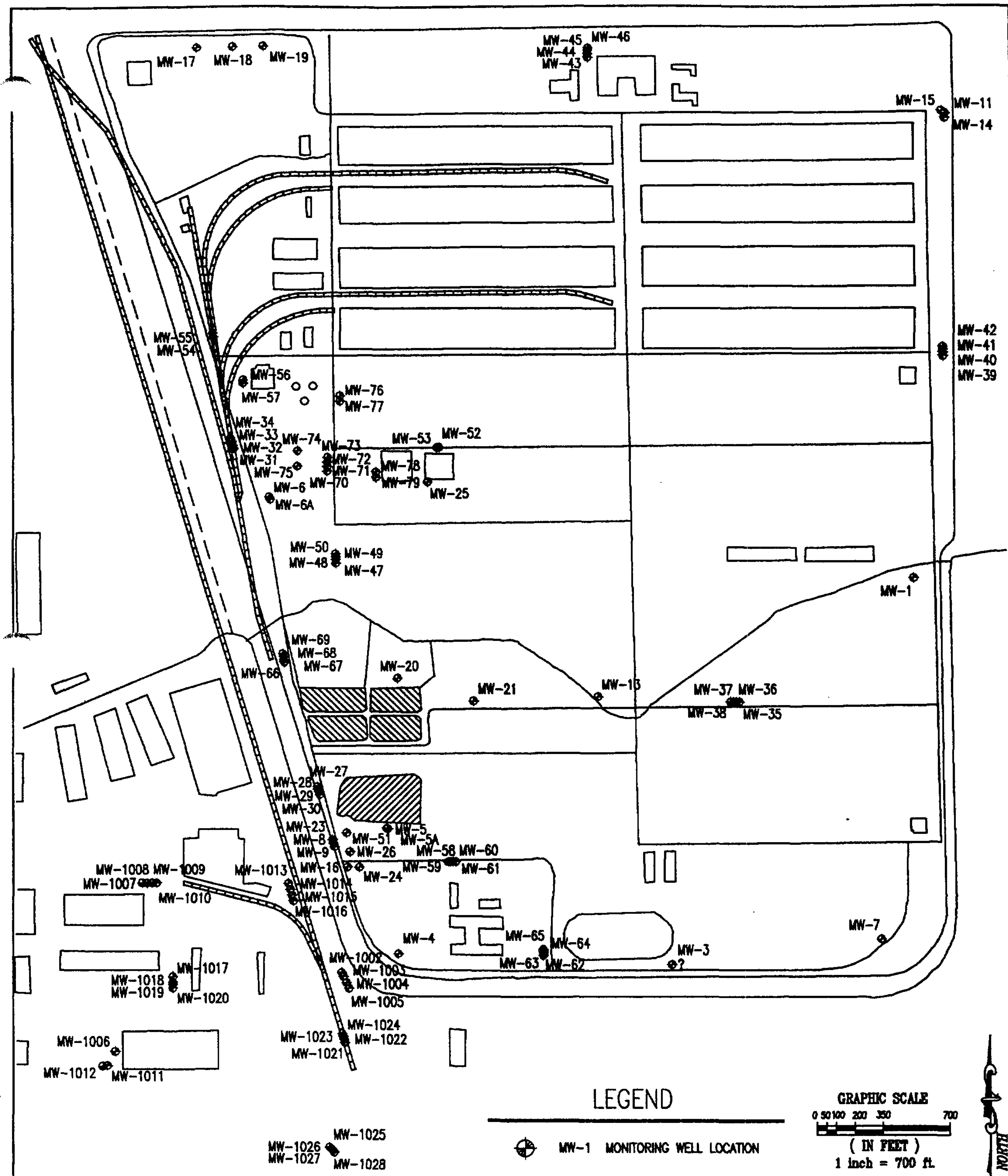
Site Name	Site Characteristics	Date of Operation	Summary of Site Investigations	Contaminants of Concern	Status
1,000 Gallon Solvent Tank #3	UST containing solvents south of Building 348.	Mid 1950's to late 1970's	Downgradient wells sampled and analyzed for VOCs. Record search shows no evidence this tank existed.	None	No evidence of an underground tank, or of groundwater contamination from tank. "No action" proposed.
500 Gallon Battery Acid Storage Tank #4	UST containing battery acid south of Building 348. Tank removed in 1986.	Mid 1950's to late 1970's	Tank was located in a below-grade cement-floored enclosure. No stains on cement. Downgradient wells show no evidence of contamination from tank.	None	No evidence of leakage from tank, or of ground-water contamination. "No action" proposed.
Sewage Outfall	Outfall at western edge of depot, north of Oxidation Lagoons.	Late 1950's to late 1960's	Outfall removed when Morrision Creek was widened and paved in 1980's.	None	Site no longer exists. "No action" proposed.
Building 320, Plating Spill	Spills from plating operations, containing metals.	1950's to 1970's	2 borings drilled to 40 feet below surface. 6 samples collected and analyzed for metals. Downgradient wells analyzed for metals. Additional samples taken during investigation of site 021, and analyzed for metals.	None	Contaminated soil removed at time of spill. Metals at background levels. "No action" proposed.
Morrison Creek	Creek running around perimeter of depot may have received wastes from industrial processes.	1940's to early 1980's	Creek was widened and paved in 1980's. Contaminated soil was removed. Depot had industrial waste disposal facilities in place prior to contaminated soil removed.	None	"No action" proposed.
Possible Open Storage Area (Building 150)	Open storage area for construction materials, west of Building 150.	1947-1950	Site stored construction materials only.	None	"No action" proposed.
Possible Open Storage Area (Buildings 246 & 248)	Open storage area for construction materials between Building 246 & Building 248.	1947-1950	Site stored construction materials only.	None	"No action" proposed.
Possible Open Storage Area (Building 426)	Open storage area for construction materials southeast of Building 426.	1947 to 1950	Area was paved by 1946, prior to storage. IR survey shows no anomalies.	None	"No action" proposed.
Possible Open Storage Area (Building 555)	Open storage area for construction materials south of Building 555.	1947 to early 1960's	Site stored construction materials only.	None	"No action" proposed.
Possible Dump Site	Open field used for vehicular activity.	1948-1950	IR survey shows no anomalies. Groundwater sample collected west of site, and analyzed for VOCs. None detected. Aerial photos do not show disposal activities.	None	No groundwater contamination found. "No action" proposed.

TABLE 1
SITE SUMMARIES

Site Name	Site Characteristics	Date of Operation	Summary of Site Investigations	Contaminants of Concern	Status
Large Disturbed Area	Surface disturbance near eastern border, reportedly the site of swamp vehicle testing.	1947 to early 1960's	Swamp vehicle testing area only.	None	"No action" proposed.
Possible Trench	Surface depression.	Early 1950's	Trench visible for less than 3 years on aerial photos. Appears to be construction storage.	None	"No action" proposed.
Possibly Fill Activity	Scarred surface area north of Oxidation Lagoons.	Early 1950's	Soil gas investigation and soil sampling in 1991/92. Sample analyzed for VOCs, SVOCs, TPH. Infrared survey shows no anomalies.	None	No contaminants detected during sampling. "No action" proposed.
Possible Dump Site	Open storage area for construction debris, northeast of Oxidation Lagoons, near the Battery Disposal Well (BDW).	Early 1950's	This area is the surface expression of activity at the BDW. Topsoil has been removed from the area. No groundwater contamination found in this area.	None	"No action" proposed.
Possible Fill Material	Soil piles from construction, south of Oxidation Lagoons.	Early 1950's to late 1970's	Area was investigated during Burn Pits RI. Samples analyzed for metals. Elevated lead found at surface.	Lead	Contaminants are associated with transfer of material from B. 300 to the South Post Burn Pits. Burn Pits area is under remediation and will include the area around site 049. "No further action" proposed.
Excavation Activity	Soil piles from construction, between Building 555 and the eastern site boundary.	Early 1960's	Construction materials only stored at site.	None	"No action" proposed.
Standing Liquid	Area of standing water near eastern border, seen in aerial photo.	Mid 1960's	Standing water is a common occurrence due to hardpan layer. This was not a disposal area.	None	"No action" proposed.
Scarred Stressed Area	Surface scarring northeast of Oxidation Lagoons.	Mid 1960's	Area investigated during investigation of site 010. 8 borings drilled to 21.5 feet below surface. Samples collected from 1.5 to 21 feet below surface. Analyzed for VOCs, SVOCs, metals.	None	Metals at background levels. Soil samples indicate no contamination. "No action" proposed.
Contractor's Spoils Area	Site consists of a number of soil piles with various amounts of construction debris (e.g. asphalt, concrete, scrap metal), and various organic material such as grass cuttings.	1966-1980's	Soil sampling of surface and near-surface soils and debris piles. Analytical result indicate presence of Freon 113, lead, zinc, PAHs and phthalates typical of the construction materials found. Site debris will be removed prior to base closure.	Benzo(a)pyrene (0.49 mg/kg)	B(a)P was detected in one sample at 1 foot below surface. The compounds found are associated with the construction debris. Risk assessment indicates no threat to human health or the environment. "No action" proposed. This area will be graded and the debris separated and removed.

TABLE 1
SITE SUMMARIES

Site Name	Site Characteristics	Date of Operation	Summary of Site Investigations	Contaminants of Concern	Status
Freon 113 Area	Site consists of a square-shaped area approximately 10 acres in size located in the vicinity of Buildings 300, 321, 325, 330, 420 and 423. Freon 113 and other VOCs in localized soil and groundwater.	1950's-1970's	Soil and soil gas samples collected from 16 borings. Groundwater samples collected from 5 borings. Samples collected from surface to 130 feet below surface. Suspected sources are drains in B. 320 sewer lines, cleaning operations in B. 420 and 423.	Freon 113 (max. 2750 ppmv) in soil gas Chloroform (max. 188 ppmv) in soil gas	An air sparging pilot test was conducted at this site. Residual contaminants in soil present no risk to human health or the environment. Short-term monitoring to confirm cleanup of soil will be conducted as needed. Groundwater concentrations are below the maximum contaminant levels (MCLs) for drinking water. "No further action" proposed.
Parking Lot 3 Soil	Site consists of a parking lot approximately 280 ft. x 360 ft. located in western-central portion of the Depot.	1946 -1951	48 soil vapor samples collected from 0-80 feet below surface. Soil samples collected from 11 borings to 80 ft. below surface. Samples analyzed for VOCs. Recent sampling from permanent soil gas monitoring stations.	Trichloroethene (max. base-line 480 ug/kg in soil gas), tetrachloroethene, 1,2-dichloroethene, 1,2-dichloroethane, carbon tetrachloride, chloroform	An air sparging/soil venting pilot test and additional venting were completed. Confirmation sampling shows TCE removal to less than one pound residual. Residual concentrations in soil present no risk to human health or the environment. Short-term monitoring to confirm soil cleanup will be conducted as needed.



KLEINFELDER

MONITORING WELL LOCATION MAP

PLATE 6

DRAWN BY: B. Walker	DATE: 12-29-94
PROJECT No. 24-150029-A51	DWG No. 0100-006

SACRAMENTO ARMY DEPOT

chromium is a potential contaminant of concern at Parking Lot 3. The Army will continue to monitor the aquifer in the Parking Lot 3 area, evaluate potential sources of chromium, and assess whether chromium is a contaminant of concern. The chromium in the aquifer in this area will be addressed with the cleanup of VOCs in the Parking Lot 3 area. MW-74 is within the radius of influence of the preferred remedy (pump and treat) for VOCs in the aquifer at the Parking Lot 3 area and can be expected to be sufficiently treated if treatment is necessary.

5.1.2 South Post Groundwater

The on-depot South Post groundwater contamination was originally addressed as an Operable Unit. However, subsequent investigations have revealed contaminants of concern above corresponding MCLs outside the depot boundaries. As a result, the off-depot groundwater contamination will be included as an area requiring remedial assessment and the interim South Post ROD will be expanded to include the entire plume. The groundwater remedy is discussed further in Section 9.

5.1.3 Battery Disposal Well (Investigation-Derived Waste)

Approximately 400 tons of soil and debris (containing heavy metals) were excavated from the Battery Disposal Well Area during investigation activities. This waste is currently stored in 16 bins located along the north side of Building 555. The waste has been sampled and the results show high levels of some heavy metals. The waste will be remediated and the remedial alternative assessment is summarized in Sections 7 through 9 of this ROD.

5.1.4 Building 300 Burn Pits Soil

The remedial assessment for soil contamination at Building 300 was assessed by comparing maximum concentrations to background levels and human health risk criteria, and by evaluating the mobility of the contaminants. A risk assessment was prepared by Kleinfelder for the Building 300 Burn Pits (Kleinfelder Report RI-9). The estimated cancer risk for the worst-case future on-site resident was 4×10^{-5}, while the estimated non-cancer risk was 1.0. The estimated cancer and non-cancer risks for the future on-site worker were approximately 2×10^{-5} and less than 1.0, respectively. Based on the risk assessment, health-based risk criteria were developed.

By comparing the maximum contaminant concentrations in the Building 300 Burn Pits to the health-based concentrations, those contaminants in the soil which may require remediation were identified. The Army found that Arochlors 1254 and 1260, arsenic, cadmium, and lead exceeded the specified health-based concentrations and will require remedial action.

5.2 NO ACTION/NO FURTHER ACTION AREAS

The areas discussed below require no action under CERCLA because the area is already protective of human health and the environment or because CERCLA does not provide the legal authority to undertake a remedial action.

5.2.1 Battery Disposal Well In-Situ Soil

The Battery Disposal Well was a disposal site for spent batteries and other debris. During the site investigation, an excavator was used to assess the extent of contamination. The excavated soil (investigation-derived waste, or IDW) was placed in hazardous waste storage bins. Alternatives for treatment/disposal of the IDW are addressed in this basewide ROD.

Following excavation, in-situ soil in the Battery Disposal Well was evaluated for contamination. Area background metals concentrations at the Battery Disposal Well (average concentrations plus two standard deviations) were compared to the maximum residual soil concentrations. Metals, with the exception of arsenic and lead, were present in concentrations indicative of background levels. It is not required to remediate soil to concentrations below naturally occurring background levels. Arsenic and lead exceeded background levels and were further evaluated.

Two sample results for arsenic exceed the background range. Since there was no known specific source for arsenic at the Battery Disposal Well, the Army judged that the two results for arsenic, 7.6 mg/kg and 7.5 mg/kg, are comparable to the upper end of the background range, 7.3 mg/kg. The background concentrations of arsenic in the geological formation being sampled may be slightly higher than the area background.

One lead sample from the bottom of the Battery Disposal Well casing was 5200 mg/kg at a depth of 49.5 feet below ground surface. However, just outside the Battery Disposal Well casing, at a depth of 55 feet below ground surface, the lead level was 3.4 mg/kg. The Army concluded that the lead accumulated at the bottom of the Battery Disposal Well casing is at the interface of the well with native soil. Migration past this point appears to be minimal. Although the maximum concentration of lead is a potential health risk, due to the depth of the sample in which 5200 mg/kg lead was detected, it is unlikely that human or ecological exposures would occur. Therefore, the maximum concentration of lead at the Battery Disposal Well is not considered a threat to human health or the environment (due to the limited extent of contamination).

In addition, soil collected from the Battery Disposal Well area was tested for leachability of metals using a modified Waste Extraction Test substituting deionized water for citrate buffer to simulate rainwater. The leachability data indicates that the danger of metals migration to groundwater is negligible, and groundwater samples downgradient of the BDW show background levels of metals. In-situ soil is not being considered for remediation.

5.2.2 Pesticide Mix Area

The Pesticide Mix Area consisted of an outdoor utility sink on the exterior wall of Building 356 from which a drain pipe ran along the building and emptied onto the ground. The site location is shown on Plate 5. Pesticides were mixed in this area and containers were rinsed in the sink. Contaminants of concern included 4,4'-DDT, 4,4'-DDE, 4,4'-DDD, prometon and chlordane. A drain well, sump, and contaminated soil were excavated and removed from this area to facilitate the site investigation. The investigation-derived waste material was disposed of in a Class I landfill. The excavation was backfilled with clean soil. Residual pesticides remaining in soil following the excavation present no threat to human health or the environment, as discussed in Section 2.2.3 of the FS.

5.2.3 Firefighter Training Area

The Firefighter Training Area reportedly consisted of a pit into which gasoline, oil, or JP4 fuel were poured and ignited. Purported site location is shown on Plate 5. Sampling was conducted in 1990 in the area where the pit was purportedly located. Nine soil borings were drilled in the area and samples were collected at the surface down to 21 feet. Samples were analyzed for volatile organic compounds, metals, and petroleum hydrocarbons. None were detected. There was no physical evidence that the site ever existed. Details of the investigation are discussed in Kleinfelder Report RI-4. No action is proposed for this site because no contamination has been found.

5.2.4 Solid Waste Management Units (SWMU) Areas

Thirteen areas were identified by AEHA in their evaluation of SWMUs (AEHA, 1989). Plate 5 shows the locations of these areas. A three-stage RCRA Facility Assessment (RFA) consisting of 1) a preliminary review, 2) a visual site inspection, and 3) a sampling visit, was conducted at each area. The preliminary review and visual site inspection were done by AEHA and the sampling visit was conducted by Kleinfelder in 1990. Background information on the RFA investigation and details on the sampling and analysis results may be found in the following Kleinfelder reports: SW-14, SW-15, SW-18, SW-21, SW-23, SW-25, and SW-32.

Based on the data obtained during the field investigations, no contamination was found at the following eight areas:

- Site 010 Possible Trenches
- Site 012 Cyanide Sump
- Site 014 Possible Shallow Lagoon
- Site 015 Building 382 Gasoline Spill
- Site 017 Outdoor Storage of Wastes
- Site 018 Old Morrison Creek
- Site 031 5,000 Gallon Waste Tank
- Site 054 Contractor's Storage Area

Results from the field investigations of these areas are summarized in Appendix E of the Basewide RI Report (Kleinfelder Report SW-27). "No action" is proposed for these areas.

Contaminants were detected at five areas, as listed below. "No action" is also proposed for these areas because they present no threat to human health or the environment, based on the health risk assessment presented in Appendix B of the Basewide Health Risk Assessment (Kleinfelder Report SW-29).

- Site 011 Two Trenches
- Site 013 Building 316 Acid Sump
- Site 016 Paint, Residue and Waste Oil Dump
- Site 019 Fill Area With Numerous Vehicles
- Site 021 Cyanide Leach Field

5.2.5 Non-SWMU Sites

Twenty nine areas were identified as non-SWMUs by AEHA (AEHA, 1989). Area locations are shown on Plate 5. Based on 1) historical record information, 2) employee interviews, 3) evaluation of data collected at or near each area, 4) downgradient groundwater monitoring, and 5) limited area sampling, no action is planned for these areas. A summary of the data evaluated for each area is provided in Appendix F of the Basewide RI Report (Kleinfelder Report SW-27). None of these areas poses a threat to human health or the environment, with the exception of Site 028, the Railyard Engine Shed. This area is contaminated with petroleum hydrocarbons only, and therefore is exempt from remedial action under CERCLA Section 101. However, a bioremediation pilot test is underway at the Railyard Engine Shed and this area will be remediated pursuant to state requirements.

5.2.6 Parking Lot 3 Soil

The Parking Lot 3 area (See Plate 5) was discussed in the FS and it was concluded that further remedial action is necessary for groundwater at this area. The soil contamination at the area, however, was significantly reduced by the air sparging pilot test initiated in August of 1993 and ending March of 1994. Mass analyses estimated that approximately 460 pounds. of TCE the primary contaminant, was extracted from the area. Borings were advanced and a residual area of TCE located. This additional TCE was vented from the soil starting in September of 1994 and ending in December of 1994. An additional 8 pounds of TCE were removed. Current data analysis indicates that 1-2 pounds remains in the soil above the groundwater. Other contaminants experienced similar reductions and are no longer detected. Residual soil contamination at the site poses no threat to human health or the environment and no further action is proposed for the soil. In addition, current data indicate that residual contaminants in soil gas in this area will not adversely impact cleanup of the aquifer. The Army will monitor residual soil gas concentrations in the soil and will then assess to what extent, if any, residual soil levels may lengthen the groundwater restoration period. The Army will present this assessment and the results of the air sparging pilot test in an updated Pilot Test Summary Report. If residual soil levels will prevent the pump and treat action from achieving cleanup levels in the estimated groundwater restoration period of nine years, additional soil remedial action will be considered. In addition, the Army will continue to collect groundwater samples in this area as part of the ongoing groundwater monitoring program for the installation.

5.2.7 Freon 113 Area

The Freon 113 area is located in the central portion of the depot and initially had an extent of contamination of approximately ten acres (see Plate 5). An extensive subsurface field investigation was conducted in September through November 1993 to assess the extent of contamination in the underlying soil, soil gas, and groundwater. The results of this investigation are included in Kleinfelder Report FR-3. The highest soil gas concentration of Freon reported was 2750 ppm-v. The greatest concentration detected in groundwater was 1000 ug/l, which is below the MCL of 1200 μg/L.

An air sparging pilot test was initiated in May of 1994 to assess to what degree Freon 113 would respond to this remedial technology. The pilot test significantly reduced the contamination in the soil and groundwater throughout the site. Mass analyses estimate that approximately 500 pounds of Freon 113, the primary contaminant found, has been extracted from the area and that less than 8 pounds may remain. Other contaminants which were present only at low concentrations at the site, have also been significantly reduced. Current residual soil contamination does not pose a threat to human health or the environment, and does not appear to present a threat to groundwater. Current groundwater contaminant levels at the site are below all established FRGs for each of the detected contaminants. The air sparging pilot test was shut down in November, 1994. No action is selected for both the soil and groundwater at the Freon 113 Site.

The Army is currently collecting samples to monitor residual concentrations in the soil gas and will then assess to what extent, if any, residual soil levels will impact the aquifer in the future. The Army will present this assessment and field results to evaluate the feasibility of implementing additional source control measures in the Pilot Test Summary Report. In addition, the Army will continue to collect groundwater samples in this area as part of the ongoing groundwater monitoring program.

5.2.8 Contractor's Spoils Area

The Contractor's Spoils Area was evaluated as a potential site for contaminant releases based on elevated surface temperatures observed in an infrared survey conducted in November 1990. This site is located east of Building 555 and is shown in Plate 5. It was used as a location to place construction debris such as concrete, asphalt, and scrap metal.

Surface samples were collected at the site in 1992. SVOCs, TPH and metals characteristic of the debris present (i.e., asphalt) were found in some samples (Kleinfelder Report SW-25). Four PAHs were detected in this area: benzo(a)pyrene, benzo(b)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene. As discussed in Section 2.2.14 of the FS, contaminants found in the area pose no threat to human health or the environment. However, because of the base closure and planned property transfer, exploration trenching was conducted at this site in 1993 to evaluate the extent of construction debris in the area. The Army intends to remove all construction spoils from the site and dispose off-base, in accordance with all appropriate laws and regulations.

5.3 ENVIRONMENTAL BASELINE SURVEY (EBS) AREAS

The Department of Defense has established policy guidelines for an environmental review process to transfer, lease, or dispose of property at closing military bases such as SADA. Prior to property transfer, the Army will prepare a Finding of Suitability to Transfer (FOST), or a Finding of Suitability to Lease (FOSL), which is supported by an Environmental Baseline Survey (EBS) for each lease or deed transfer.

The EBS investigation process includes a detailed examination of federal government documents and studies, searches of records and permits from regulatory agencies, interviews of current and former employees, and visual inspections to identify signs of possible contamination of all buildings and grounds. For the EBS investigation, the depot was divided into 100 study areas, which overlap the areas addressed by this Basewide ROD. A comprehensive EBS report is being prepared for each study area. The basewide FS includes a summary of the findings of the investigation in the EBS reports for each study area.

5.4 SUMMARY OF RCRA FACILITY PERMITS AND CLOSURE ACTIVITIES

SADA currently holds a RCRA permit issued in August 1992 for a hazardous waste storage facility, described as Building 412. As part of closure of the Depot, the Army has submitted a Closure Plan for the facility. The Closure Plan was submitted in November 1994 and the State anticipates approval of the Plan by April 1995. Upon approval, the Army will verify the area is not contaminated by conducting confirmation sampling. The Army plans to complete these activities by July 1995 with State approval for final closure by September 1995.

SADA is also under an Enforcement Order to close Building 411, the former Battery Acid Dumping Facility. Closure for Building 411 has been implemented and the State is reviewing the closure certification. State acceptance of the closure certification is planned for February 1995.

6 SUMMARY OF SITE RISKS

6.1 HUMAN HEALTH RISKS

As part of the basewide RI/FS, the Army prepared a basewide health risk assessment report. The purpose of the health risk assessment was to estimate health risks in humans following exposures to contaminants at the depot. Risks were estimated for the following conditions:

- Baseline ("No Action") conditions,
- Current (partially remediated) conditions, and
- Cleanup (fully remediated) conditions

The reason for evaluating each of these conditions was to show how much the human health risks have been, or will be, reduced by remedial activities conducted at the depot.

Table 2 presents definitions of the key terms from the human health risk assessment that are used in this ROD. A summary of the basewide human health risk assessment is presented in this section.

6.1.1 Contaminants of Concern

Groundwater and soil at SADA are known to be contaminated. Therefore, contaminants of concern were identified for both of these environmental media. Eight chemicals of potential concern were identified in groundwater at the depot. These chemicals include the following volatile organic chemicals (VOCs): carbon tetrachloride, chloroform, 1,2-dichloroethane, *cis*-1,2-dichloroethylene, *trans*-1,2-dichloroethylene, 1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113), tetrachloroethene (PCE), and trichloroethene (TCE). Baseline, current, and cleanup concentrations of the groundwater contaminants are shown in Table 3.

A total of 32 chemicals were identified as chemicals of potential concern in soil at the depot. These chemicals include eleven metals, seven organochlorine pesticides, polychlorinated biphenyls (PCBs), six polynuclear aromatic hydrocarbons (PAHs), and seven volatile or semi-volatile organic chemicals. Baseline, current, and cleanup concentrations of the soil contaminants are shown in Table 4.

TABLE 2
DEFINITIONS OF RISK TERMS

Carcinogen:	A substance that, with long term exposure, may increase the incidence of cancer in humans.
Chronic Daily Intake (CDI):	The average amount of chemical absorbed by an individual on a daily basis over a substantial portion of his/her lifetime.
Exposure:	The opportunity to receive a dose through direct contact with a chemical or medium containing a chemical.
Exposure Assessment:	The process of evaluating, for a population at risk, the amounts of chemicals to which individuals are exposed, or the distribution of exposures within a population, or the average exposure of an entire population.
Hazard Index (HI):	An EPA method used to assess the potential noncarcinogenic risk. The ratio of the CDI to the chronic RfD (or other suitable toxicity value for noncarcinogens) is calculated. If it is less than one, then the exposure represented by the CDI is judged unlikely to produce an adverse noncarcinogenic effect. A cumulative, endpoint-specific HI can also be calculated to evaluate the risks posed by exposure to more than one chemical by summing the CDI/RfD ratios for all the chemicals of interest that exert a similar effect on a particular organ. This approach assumes that multiple subthreshold exposures could result in an adverse effect on a particular organ and that the magnitude of the adverse effect will be proportional to the sum of the ratios of the subthreshold exposures. If the cumulative HI is greater than one, then there may be concern for public health risk.
Reference Dose (RfD):	An estimate, with uncertainty which may span more than an order of magnitude, of a daily exposure level for human population that is likely to be without an appreciable risk of deleterious effects.
Risk:	The nature and probability of occurrence of an unwanted, adverse effect on human life, health, or on the environment.
Risk Assessment or Health Evaluation:	The characterization of the potential adverse effect on human life, health, or on the environment. According to the National Research Council's Committee on the Institutional Means for Assessment of Health Risk, human health risk assessment includes: (1) description on the potential adverse health effects based on an evaluation of results of epidemiologic, clinical, toxicologic, and environmental research; (2) extrapolation from those results to predict the types and estimate the extent of health effect in humans under given conditions of exposure; (3) judgments as to the number of characteristics of persons exposed at various intensities and durations; (4) summary judgments on the existence and overall magnitude of the public-health program; and (5) characterization of the uncertainties inherent in the process of inferring risk.
Slope Factor:	A plausible upper-bound estimate (set at 95%) of the probability of a response (i.e. cancer) per unit intake of a chemical over a lifetime.

TABLE 3
Summary of Volatile Organic Chemical (VOC) Concentrations in A-Zone Groundwater Monitoring Wells*
Sacramento Army Depot

Well	Site	95% UCL Concentration (ug/l)++							
		Chloroform	TCE	PCE	C-1,2-DCE	t-1,2-DCE	1,2-DCA	Carbon Tet.	Freon 113
Baseline Conditions[1]									
MW0003	South Post/Run Track	2.30	2.40	2.30	NC	2.35	2.33	2.45	NC
MW0004	Navy/Marine Rsrv Ctr	0.32	6.02	0.10	NC	0.51	0.26	0.20	NC
MW0005	SW Corner/Burn Pits	13.13	90.48	30.62	NC	4.21	1.45	1.02	NC
MW0006	Western Boundary	1.52	2.54	1.51	NC	1.60	1.57	1.73	NC
MW0013	Laser Range	3.00 +	3.00 +	3.00 +	NC	3.00 +	3.00 +	3.00 +	NC
MW0016	SW Corner/Burn Pits	1.80	54.42	0.58	NC	7.88	0.65	0.20	NC
MW0020	N of Oxidation Lags	3.37	5.50	3.37	NC	5.75	3.32	3.36	NC
MW0024	SW Corner/Burn Pits	3.54	71.06	6.97	NC	9.93	1.37	1.89	NC
MW0025	Tank 2	12.02	12.82	11.91	13.57	12.62	12.14	12.14	768.60
MW0030	West Burn Pits	2.83	25.28	2.81	NC	3.64	2.79	2.79	NC
MW0050	North Airstrip	2.29	13.23	2.19	NC	2.21	2.21	2.38	NC
MW0053	Tank 2	5.67	0.81	0.78	0.84	0.78	0.87	0.78	43.59
MW0069	West Laser Range	NA	NA	NA	NA	NA	NA	NA	NA
MW0073	Parking Lot 3	18.93	61.86	2.33	0.30	2.25	2.32	2.25	2.35
MW0074	Parking Lot 3	44.00	8.40	18.00	7.60	7.60	3.00	1.50	2.50
MW0077	Parking Lot D	62.00	7.60	22.00	14.00	14.00	6.90	1.60	2.50
MW0079	Building 420	NA	NA	NA	NA	NA	NA	NA	NA
MW1005	SP RR	1.81	19.73	1.67	NC	4.22	1.71	1.71	NC
MW1006	8152 Elder Creek Rd	1.67	1.91	1.67	NC	1.76	1.72	1.72	NC
MW1010	Signal Court	2.01	2.14	2.01	NC	2.11	2.03	2.03	NC
MW1016	SP RR SPUR #2	1.31	5.58	1.28	NC	1.49	1.35	1.33	NC
MW1020	Black Magic	1.59	27.57	1.50	NC	3.96	1.56	1.54	NC
MW1024	SP RR #3	NA	NA	NA	NA	NA	NA	NA	NA
MW1028	Roadway Cluster	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 3

Summary of Volatile Organic Chemical (VOC) Concentrations in A-Zone Groundwater Monitoring Wells*

Sacramento Army Depot

		Concentration (ug/l)#							
Well	Site	Chloroform	TCE	PCE	C-1,2-DCE	t-1,2-DCE	1,2-DCA	Carbon Tet.	Freon 113
Current Conditions[1]									
MW0003	South Post/Run Track	0.48	0.40	0.25	0.25	0.25	0.25	0.25	0.25
MW0004	Navy/Marine Rsrv Ctr	0.25	1.96	0.25	0.25	0.25	0.25	0.25	0.25
MW0005	SW Corner/Burn Pits	0.25	1	0.25	0.25	0.25	0.25	0.25	0.25
MW0006	Western Boundary	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
MW0013	Laser Range	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
MW0016	SW Corner/Burn Pits	0.25	7.3	0.6	0.8	0.25	0.25	0.25	0.25
MW0020	N of Oxidation Lags	0.25	2.73	1.80	1.83	0.25	0.25	0.25	0.25
MW0024	SW Corner/Burn Pits	2.11	26.32	3.33	2.88	0.25	0.25	0.25	0.25
MW0025	Tank 2	0.99	0.25	0.25	0.25	0.25	0.5	0.25	175
MW0030	West Burn Pits	0.25	3.3	0.25	0.25	0.25	0.25	0.25	0.25
MW0050	North Airstrip	2.30	16	0.25	0.25	0.25	0.25	1.2	0.25
MW0053	Tank 2	12	0.25	0.25	0.25	0.25	0.5	0.25	29
MW0069	West Laser Range	0.25	0.5	0.25	0.25	0.25	0.25	0.25	0.25
MW0073	Parking Lot 3	16	38	0.73	0.25	0.25	0.5	0.25	1.8
MW0074	Parking Lot 3	23	2.6	6.7	5.3	0.25	0.25	0.25	0.25
MW0077	Parking Lot D	9.10	0.25	0.25	0.25	0.25	0.25	0.6	0.25
MW0079	Building 420	3.2	1.4	0.25	0.25	0.25	0.25	0.25	0.25
MW1005	SP RR	0.25	14.96	0.25	3.06	0.25	0.25	0.25	0.25
MW1006	8152 Elder Creek Rd	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
MW1010	Signal Court	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
MW1016	SP RR SPUR #2	0.25	20	0.26	3.7	0.25	0.25	0.25	0.25
MW1020	Black Magic	0.25	1	0.25	0.25	0.25	0.25	0.25	0.25
MW1024	SP RR #3	0.25	6.3	0.25	1.4	0.25	0.25	0.25	0.25
MW1028	Roadway Cluster	0.25	14	0.25	2.8	0.25	0.25	0.25	0.25

TABLE 3

Summary of Volatile Organic Chemical (VOC) Concentrations in A-Zone Groundwater Monitoring Wells*

Sacramento Army Depot

Well	Site	Concentration (ug/l)#							
		Chloroform	TCE	PCE	C-1,2-DCE	t-1,2-DCE	1,2-DCA	Carbon Tet.	Freon 113
Cleanup Conditions[3]									
MW0003	South Post/Run Track	0.48	0.40	0.25	0.25	0.25	0.25	0.25	0.25
MW0004	Navy/Marine Rsrv Ctr	0.25	1.96	0.25	0.25	0.25	0.25	0.25	0.25
MW0005	SW Corner/Burn Pits	0.79	5.00 **	0.72	1.38	0.25	0.25	0.25	0.25
MW0006	Western Boundary	0.67	5.00 **	0.25	0.25	0.25	0.25	0.41	0.25
MW0013	Laser Range	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
MW0016	SW Corner/Burn Pits	1.49	5.00 **	3.26	3.29	0.66	0.25	0.25	0.78
MW0020	N of Oxidation Lags	0.25	2.73	1.80	1.83	0.25	0.25	0.25	0.25
MW0024	SW Corner/Burn Pits	2.11	5.00 **	3.33	2.88	0.25	0.25	0.25	0.25
MW0025	Tank 2	10.16	5.00 **	5.00 **	6.00 **	10.00 **	0.50 **	0.50 *	693.44
MW0030	West Burn Pits	0.25	5.00 **	0.26	0.91	0.42	0.26	0.27	0.34
MW0050	North Airstrip	2.08	5.00 **	0.62	0.25	0.25	0.25	0.50 *	0.25
MW0053	Tank 2	8.08	0.89	0.69	0.74	0.69	0.50 **	0.50 *	42.73
MW0069	West Laser Range	0.25	1.51	0.25	0.25	0.25	0.25	0.25	0.25
MW0073	Parking Lot 3	19.35	5.00 **	1.83	0.25	1.70	0.50 **	0.50 *	1.66
MW0074	Parking Lot 3	23	2.9	5.00 **	5.5	0.25	0.50 **	0.25	0.25
MW0077	Parking Lot D	27.36	1.55	0.25	0.25	0.25	0.25	0.50 *	0.25
MW0079	Building 420	2.7	1.6	0.25	0.25	0.25	0.25	0.50 *	0.25
MW1005	SP RR	0.25	5.00 **	0.25	3.06	0.25	0.25	0.25	0.25
MW1006	8152 Elder Creek Rd	1.07	1.11	1.07	0.25	1.07	0.50 **	0.50 *	0.25
MW1010	Signal Court	0.97	1.02	0.97	0.25	0.97	0.50 **	0.50 *	0.25
MW1016	SP RR SPUR #2	0.50	5.00 **	0.26	6.00 **	3.25	0.33	0.27	0.33
MW1020	Black Magic	0.25	2.67	0.25	0.37	0.25	0.25	0.25	0.25
MW1024	SP RR #3	0.25	5.00 **	0.25	1.14	0.25	0.25	0.25	0.25
MW1028	Roadway Cluster	0.25	5.00 **	0.25	2.7	0.25	0.25	0.25	0.25

NA: Not Available (well not installed at this time).
NC: Not Calculated due to lack of analytical data.
* Only A-Zone wells in which VOCs detected more than two times included in summary. For well location map, see Plate 6.
** California primary Maximum Contaminant Level (MCL)
\+ Maximum concentration of two results.
\++ 95% Upper Confidence Limit (UCL) derived using equation in Section 3.3.1; used as baseline groundwater chemical concentrations in risk assessment.
\# Most recent groundwater monitoring; one-half times the reporting limit used for results reported as ND (Not Detected).
1 Baseline Conditions assumed to be represented by groundwater monitoring data collected from January 1980 through October of 1989 for all wells except Freon 113/Parking Lot 3 wells (where baseline data = data collected from January 1992 through July 1993).
2 Current Conditions assumed to be represented by groundwater monitoring data collected from April 1994 through September 1993.
3 Cleanup Conditions assumed to be the same as current conditions except California primary Maximum Contaminant Levels (MCLs) used for chemicals detected at concentrations greater than their MCLs.

TABLE 4
SUMMARY OF CHEMICAL CONCENTRATIONS
IN SOIL AT THE SACRAMENTO ARMY DEPOT

SITE	CHEMCIAL	SOIL CONCENTRATIONS (95% UCL mg/kg)				
		Baseline [1]	Current [2]		Cleanup [3]	
Tank 2	Benzo[a]anthracene	4.44	4.44	(Baseline)	4.44	(Baseline)
	Benzo[g,h,i,]perylene	4.45	4.45	(Baseline)	4.45	(Baseline)
	2-Butanone	38.1	1.2	(RAO)	1.2	(RAO)
	Chrysene	4.51	4.51	(Baseline)	4.51	(Baseline)
	Dieldrin	0.204	0.204	(Baseline)	0.204	(Baseline)
	2,4-Dimethylphenol	4.524	4.52	(Baseline)	4.52	(Baseline)
	Ethylbenzene	200.151	6	(RAO)	6	(RAO)
	Heptachlor epoxide	0.114	0.114	(Baseline)	0.114	(Baseline)
	Indeno[1,2,3-c,d]pyrene	4.45	4.45	(Baseline)	4.45	(Baseline)
	Naphthalene	2.583	2.58	(Baseline)	2.58	(Baseline)
	Perchlorothylene (PCE)	18.7	0.2	(RAO)	0.2	(RAO)
	Xylenes	1173.76	23	(RAO)	23	(RAO)
Oxidation Lagoons	Antimony	28.2	28.2	(Baseline)	3	(Background)
	Arsenic	10	10	(Baseline)	7.3	(95% UCL,BG)
	Cadmium	335.4	335.4	(Baseline)	40	(RAO)
	Chromium (total)	351.7	351.7	(Baseline)	33	(Background)
	Copper	251.6	251.6	(Baseline)	29	(Background)
	Mercury	0.5	0.5	(Baseline)	0.05	(Background)
	Nickel	167.6	167.6	(Baseline)	28	(Background)
	Silver	13.8	13.8	(Baseline)	0.29	(Background)
	Zinc	1054.9	1054.9	(Baseline)	48.5	(Background)
Burn Pits (South Post)	Antimony	96.5	96.5	(Baseline)	3	(Background)
	Arsenic	39.1	39.1	(Baseline)	7.3	(95% UCL, BG)
	Cadmium	351.7	351.7	(Baseline)	88	(RAO)
	Chromium VI	47.8	47.8	(Baseline)	16	(RAO)
	cis-1,2-Dichloroethylene	0.11	0.11	(Baseline)	0.005	(RAO)
	Lead	2094.7	2094.7	(Baseline)	174	(RAO)
	PCBs	0.43	0.43	(Baseline)	0.43	(Baseline)
	PCE	0.278	0.005	(Baseline)	0.005	(RAO)
	Trichloroethylene (TCE)	0.236	0.005	(Baseline)	0.005	(RAO)
Pesticide Mix Area	4,4'-DDT	4.333	1.2	(Max. Resid.)	1.2	(Max. Resid.)
	4,4'-DDD	0.345	0.11	(Max. Resid.)	0.11	(Max. Resid.)
	4,4'-DDE	0.66	0.24	(Max. Resid.)	0.24	(Max. Resid.)
	Chlordane	0.41	ND (0.05)	(Max. Resid.)	D (0.05)	(Max. Resid.)
	gamma-BHC	0.043	ND (0.05)	(Max. Resid.)	D (0.05)	(Max. Resid.)
Battery Disposal Well	Cadmium	1.22	1.22	(Max. Resid.)	1.22	(Max. Resid.)
	Lead	243.63	398	(Max. Resid.*)	398	(Max. Resid.*)
	Benzo[a]pyrene	0.256	(Removed)		0.266	(Baseline)

TABLE 4
SUMMARY OF CHEMICAL CONCENTRATIONS
IN SOIL AT THE SACRAMENTO ARMY DEPOT

SITE	CHEMCIAL	SOIL CONCENTRATIONS (95% UCL mg/kg)				
		Baseline [1]	Current [2]		Cleanup [3]	
Building 300	Arsenic	11.52	11.52	(Baseline)	7.3	(Baseline)
	Cadmium	304.87	304.87	(Baseline)	9	(RAO)
	Lead	4714.23	4714.23	(Baseline)	500	(RAO)
	PCBs (Arochlor 1260)	0.266	0.266	(Baseline)	0.266	(Baseline)
Freon 113 Area@	Carbon Tetrachloride	ND	ND		ND	
	Chloroform	ND	ND		ND	
	1,1-Dichloroethene	ND	ND		ND	
	Freon 113	ND	ND		ND	
	PCE	ND	ND		ND	
	TCE	ND	ND		ND	
Parking Lot 3@	Carbon Tetrachloride	0.003	0.003	(Baseline)	0.003	(Baseline)
	Chloroform	0.008	0.008	(Baseline)	0.008	(Baseline)
	1,2-Dichloroethane	0.003	0.003	(Baseline)	0.003	(Baseline)
	TCE	0.076	0.076	(Baseline)	0.076	(Baseline)

RAO = Remedial Action Objective.
95% UCL = 95% Upper Confidence Limit
BG = Background
ND = Not Detected
@ = Groundwater is primary contaminated medium at this site.
Max. Resid = Maximum residual concentration remaining in soil.
[1] = Based on chemical analytical data collected during remedial investigations, prior to treatability studies or remediation (cleanup)
[2] = Based on chemical analytical data that are representative of site conditions as of December, 1993.
[3] = Based on RAOs (Remedial Action Objectives) for site.

The risks posed by each of the chemicals of concern were estimated in the human health risk assessment. Based on their detection frequencies, their concentrations, and their estimated health risks under baseline conditions, the following chemicals of concern were identified as targets for remedial action:

Groundwater Contaminants

- carbon tetrachloride
- chloroform
- 1,2-dichloroethane
- PCE
- TCE

These chemicals were detected most frequently and at the greatest concentrations in the shallow aquifer, referred to as the A/B zone, located approximately 80 to 148 feet below ground surface. There are three main areas of groundwater contamination at SADA: the Southpost area, Parking Lot 3, and the Freon 113 area.

Soil Contaminants

Metals:

- antimony (Burn Pits, Building 300)
- arsenic (Oxidation Lagoons, Burn Pits, Building 300)
- cadmium (Oxidation Lagoons, Burn Pits, Building 300)
- chromium VI (Burn Pits)
- lead (Burn Pits, Battery Disposal Well, Building 300)

Organic Chemicals:

- benzo[a]pyrene (Battery Disposal Well)
- chlordane (Pesticide Mix Area)
- chrysene (Tank 2)
- 4,4'-DDT (Pesticide Mix Area)
- dieldrin (Tank 2)

- PCBs (Burn Pits, Building 300)

The estimated risks from exposure to these chemicals are discussed in Section 6.1.4. The risks from the VOCs in groundwater are mainly due to the potential ingestion of groundwater contaminants and/or inhalation of chemical vapors from groundwater (assuming that future on-site workers or residents would use groundwater for drinking and/or showering, etc.). With the exception of chromium VI, the risks from soil contaminants are mainly due to potential incidental ingestion and/or dermal absorption. Risks from chromium VI in soil at the Burn Pits are due to potential inhalation of chromium VI in fugitive dust.

6.1.2 Exposure Assessment

In the exposure assessment, two receptors were identified as being representative of maximally exposed individuals at SADA. These receptors are a potential future on-site worker and a worst-case future on-site resident. Although the depot will not be developed for residential use, the residential scenario was presented for the purpose of making decisions regarding future land use and so that potential worst-case conditions are evaluated.

The following exposure pathways were considered in the human health risk assessment:

- incidental ingestion of chemicals in soil
- dermal absorption of chemicals in soil
- inhalation of VOC vapors from soil
- inhalation of non-VOCs in fugitive dust
- ingestion of VOCs in groundwater (worst-case)
- inhalation of VOC vapors in groundwater (worst-case)

It is unlikely that future workers and/or residents on the depot will be exposed to groundwater. The groundwater exposure pathways were included only for the purpose of evaluating worst-case conditions.

Exposure point concentrations are the chemical concentrations in the air, soil, or water to which the receptors are exposed. For both baseline and current conditions, groundwater monitoring data were used to estimate the exposure point concentrations for VOCs in groundwater. For cleanup conditions, it was assumed that groundwater contaminants would be remediated to their Maximum Contaminant Levels (MCLs).

Analytical data collected during the remedial investigations were used to estimate the baseline exposure point concentrations for soil contaminants. For current conditions, residual chemical concentrations were used for sites that have already been remediated. Furthermore, Remedial Action Objectives (RAOs) from the Feasibility Study were used as the exposure point concentrations for soil contaminants at sites yet to be remediated (cleanup conditions).

The U.S. EPA's computer model, Industrial Source Complex Short Term (ISCST, version 2), was used to estimate the emission of chemicals from soil to air and the subsequent air concentrations of chemicals.

Chronic daily intake (CDI) levels were then estimated for each receptor for each pathway using equations and exposure factors recommended by the U.S. EPA and/or the California DTSC. The exposure factors for each receptor are summarized in Table 5. The chronic daily intake levels were expressed in milligrams chemical per kilogram body weight per day (mg/kg-day). The chronic daily intake levels were combined with chemical toxicity values (described in the following section) to estimate the health risks for each receptor.

6.1.3 Toxicity Assessment

Two types of toxicologic effects were considered in this assessment: carcinogenic (cancer-causing) effects and non-carcinogenic effects. Toxicity values are chemical-specific and are derived by the U.S. EPA and/or the California EPA for each type of effect. For non-carcinogenic effects, U.S. EPA reference doses (RfDs) or reference concentrations (RfCs) were used as toxicity values for ingestion or inhalation of contaminants, respectively. These RfD/RfCs represent exposure levels that are unlikely to result in adverse health effects during lifetime exposures. The RfDs/RfCs were obtained from the U.S. EPA's Integrated Risk Information System (IRIS, a computer database) or the Health Effects Assessment Summary Tables (HEAST, U.S. EPA, March 1993).

For carcinogenic effects, California EPA cancer slope (potency) factors were used as the toxicity values. If California slope factors (SFs) were not available, U.S. EPA SFs were used. Of the 38 different chemicals of concern in groundwater or soil at the Depot, 21 chemicals are classified as carcinogens by the California EPA or the U.S. EPA. Three of the carcinogens, arsenic, chromium VI (by inhalation only), and nickel (by inhalation only) are classified as known human

TABLE 5

PARAMETERS USED FOR CHEMICAL CHRONIC DAILY INTAKE (CDI) EQUATIONS
SITEWIDE HEALTH RISK ASSESSMENT
SACRAMENTO ARMY DEPOT

Receptor	Pathways	General Equation: CDI = (C x IR x CF x EF x ED)/(BW x AT)							
		C	IR	CF	EF (days/yr)	ED (years)	BW (kg)	AT (years) NonCanc.	AT (years) Cancer
Future On-Site Resident	**Soil Exposures:**								
	Soil ingestion	95% UCL* (mg/kg)	120 mg/day	10^{-6} kg/mg	350	30	59	30	70
	Dermal abs. of soil	95% UCL* (mg/kg)	--	10^{-6} kg/mg	350	30	70	30	70
	Air Exposures:								
	Fug. Dust Inhalation	95% UCL* (mg/kg)	20 m^3/day	--	350	30	70	30	70
	Vapor Inhalation	95% UCL* (mg/kg)	20 m^3/day	--	350	30	70	30	70
	Groundwater Exposures:								
	Groundwater ingestion	95% UCL* (mg/L)	2 L/day	--	350	30	70	30	70
	Vapor inhalation (indoor)	95% UCL* (mg/L)	15 m^3/day	--	350	30	70	30	70
Future On-Site Worker	**Soil Exposures:**								
	Soil ingestion	95% UCL* (mg/kg)	100 mg/day	10^{-6} kg/mg	250	25	70	25	70
	Dermal abs. of soil	95% UCL* (mg/kg)	--	10^{-6} kg/mg	250	25	70	25	70
	Air Exposures:								
	Fug. Dust Inhalation	95% UCL* (mg/kg)	20 m^3/day	--	250	25	70	25	70
	Vapor Inhalation	95% UCL* (mg/kg)	20 m^3/day	--	250	25	70	25	70
	Groundwater Exposures:								
	Groundwater ingestion	95% UCL* (mg/L)	1.4 L/day	--	250	25	70	25	70
	Vapor inhalation (indoor)	95% UCL* (mg/L)	15 m^3/day	--	250	25	70	25	70

* 95% UCL = 95% Upper Confidence Limit (UCL) of baseline or current analytical data used as chemical concentrations for baseline or current conditions, respectively; maximum residual concentrations or remedial action goals (RAOs) used as chemical concentrations for sites or chemicals which have been remediated.

CDI = Chronic Daily Intake
C = Chemical Concentration
IR = Intake Rate
CF = Conversion Factor
EF = Exposure Frequency
ED = Exposure Duration
BW = Body Weight
AT = Averaging Time

carcinogens (Group A), while the remaining 18 carcinogens are classified as probable human carcinogens (Group B).

Table 6 presents a summary of the toxicity values used in this assessment.

6.1.4 Risk Characterization

In the risk characterization, noncarcinogenic risks and carcinogenic risks were estimated for each receptor (i.e., the future on-site worker and the future on-site resident) under three different site conditions: baseline, current, and cleanup (remediated). Noncarcinogenic risks were estimated using the Hazard Index (HI) approach. In this approach, a hazard quotient (HQ) is derived for each chemical by dividing the CDI by the RfD; then the HQs for all of the chemicals are added together and expressed as the HI. An HQ or HI greater than unity (1.0) indicates concern for potential health effects.

Carcinogenic risks were estimated by multiplying the chronic daily intakes by chemical-specific cancer potency (slope) factors. The cancer risks were expressed as the upper-bound probability (chance) of an individual developing cancer as a result of exposure to chemicals at the site. One of the remediation objectives of the Superfund program is to reduce ambient chemical concentrations to levels associated with excess lifetime cancer risks in the range of 10^{-7} (1 in 10,000,000) to 10^{-4} (1 in 10,000).

Under baseline conditions, the greatest total carcinogenic risk for the potential on-site worker was approximately 2×10^{-4}, due mainly to groundwater and soil exposures in the South Post (Burn Pits) area. Under current conditions the greatest total carcinogenic risk for the potential on-site worker was reduced to approximately 6×10^{-5}, mainly as a result of contaminant removal by the groundwater treatment system in the South Post Area. Under cleanup conditions, the greatest total carcinogenic risk for the potential on-site worker was reduced to approximately 3×10^{-5}. This represents a total risk reduction for a potential on-site resident of approximately one order of magnitude after cleanup. Furthermore, the total estimated cancer risks under cleanup conditions are due mainly to exposures to chemicals in groundwater (e.g. TCE and chloroform) at their Maximum Contaminant Levels (MCLs) for drinking water and to exposures to background concentrations of arsenic in soil. Cancer risks for a potential on-site resident are approximately two times the risks estimated for workers under each condition.

TABLE 6
TOXICITY VALUES FOR CHEMICALS OF CONCERN AT THE SACRAMENTO ARMY DEPOT

SITE	CHEMICAL	Cancer Potency Factors*				Reference Doses/Concentrations		
		Oral		Inhalation		Oral	Inhalation	
		Unit Risk (ug/L)$^{-1}$	Dose (mg/kg-day)$^{-1}$	Unit Risk (ug/m^3)$^{-1}$	Dose (mg/kg-day)$^{-1}$	RfD (mg/kg-day)	RfC (mg/m^3)	RfD (mg/kg-day)
Tank 2	Benzo[a]anthracene*	3.43E-04 **	12 (4)	3.43E-03 **	12 (4)	NA	NA	NA
	Benzo[g,h,i]perylene	--	--	--	--	NA	NA	NA
	2-Butanone	--	--	--	--	0.6 (1)	1 (1)	0.29 **
	Chrysene*	3.43E-04 **	12 (4)	3.43E-03 **	12 (4)	NA	NA	NA
	Dieldrin	4.60E-04 (1)	16 (1)	4.60E-03 (1)	16.1 **	0.00005 (1)	NA	0.00005 (3r)
	2,4-Dimethylphenol	--	--	--	--	0.02 (1)	0.07 ++	0.02 (3r)
	Ethylbenzene	--	--	--	--	0.1 (1)	1 (1)	0.29 **
	Heptachlor epoxide	3.71E-04 **	13 (4)	3.71E-03 **	13 (4)	1.3E-05 (1)	NA	0.000013 (3r)
	Indeno[1,2,3-c,d]pyrene*	3.43E-04 **	12 (4)	3.43E-03 **	12 (4)	NA	NA	NA
	Naphthalene	--	--	--	--	0.004 (1)	0.014 ++	0.004 (3r)
	Perchloroethylene (PCE)	1.46E-06 **	0.05 (4)	1.46E-05 **	0.05 (4)	0.01 (1)	NA	0.01 (3r)
	Xylenes	--	--	--	--	2 (1)	0.7 ++	0.2 (3r)
Oxidation Lagoons	Antimony	--	--	--	--	0.0004 (1)	NA	NA
	Arsenic	5.00E-05 (1)	1.75 **	4.30E-03 (1)	15 (1a)	0.0003 (1)	NA	NA
	Cadmium	--	--	4.29E-03 **	15 (4)	0.001 (1f)	NA	NA
	Chromium (total)	--	--	--	--	1 (1)	NA	NA
	Copper	--	--	--	--	0.037 (2)	NA	NA
	Mercury	--	--	--	--	NA	0.0003 (2)	0.000086 **
	Nickel	--	--	2.60E-04 **	0.9 (4)	0.02 (1)	NA	NA
	Silver	--	--	--	--	0.005 (1)	0.0175 ++	0.005 (5)
	Zinc	--	--	--	--	0.3 (1)	NA	NA
Burn Pits	Antimony	--	--	--	--	0.0004 (1)	NA	NA
	Arsenic	5.00E-05 (1)	1.75 **	4.30E-03 (1)	15 (1a)	0.0003 (1)	NA	NA
	Cadmium	--	--	4.29E-03 **	15 (4)	0.001 (1f)	NA	NA
	Chromium VI	1.20E-05 **	0.42 (4)	1.46E-01 **	510 (4)	0.005 (1)	NA	NA
	cis-1,2-Dichloroethylene	--	--	--	--	0.01 (1)	0.035 ++	0.01 (3r)
	Lead	NA	NA	NA	NA	NA	NA	NA
	PCBs	2.20E-04 (1)	7.7 (1)	2.20E-03 **	7.7 (3r)	NA	NA	NA
	PCE	1.46E-06 **	0.05 (4)	1.46E-05 **	0.05 (4)	0.01 (1)	0.035 ++	0.01 (3r)
	Trichloroethylene (TCE)	1.46E-06 **	0.015 (4)	2.86E-06 **	0.01 (4)	0.006 (3e)	0.021 ++	0.006 (3r)
Pesticide Mix Area	4,4'-DDT	9.70E-06 (1)	0.34 (1)	9.71E-05 **	0.34 (3r)	0.0005 (1)	0.00175 ++	0.0005 (3r)
	4,4'-DDD	6.90E-06 (1)	0.24 (1)	6.86E-05 **	0.24 (3r)	0.0005 (5)	0.00175 ++	0.0005 (5)
	4,4'-DDE	9.70E-06 (1)	0.34 (1)	9.71E-05 **	0.34 (3r)	0.0005 (5)	0.00175 ++	0.0005 (5)
	Chlordane	3.70E-05 (1)	1.3 (1)	3.71E-04 **	1.3 (2)	0.00006 (1)	0.00021 ++	0.00006 (3r)
	gamma-BHC	1.14E-04 **	4 (4)	1.14E-03 **	4 (4)	0.0003 (1)	0.00105 ++	0.0003 (3r)

TABLE 6
TOXICITY VALUES FOR CHEMICALS OF CONCERN AT THE SACRAMENTO ARMY DEPOT

SITE	CHEMICAL	Cancer Potency Factors+				Reference Doses/Concentrations		
		Oral		Inhalation		Oral	Inhalation	
		Unit Risk $(ug/L)^{-1}$	Dose $(mg/kg\text{-}day)^{-1}$	Unit Risk $(ug/m^3)^{-1}$	Dose $(mg/kg\text{-}day)^{-1}$	RfD (mg/kg-day)	RfC (mg/m^3)	RfD (mg/kg-day)
Battery Disp. Well	Cadmium	--	--	4.29E-03 **	15 (4)	0.001 (1f)	NA	NA
	Lead	NA	NA	NA	NA	NA	NA	NA
	Benzo[a]pyrene	3.43E-04 **	12 (4)	3.43E-03 **	12 (4)	NA	NA	NA
Building 300	Arsenic	5.00E-05 (1)	1.75 **	4.30E-03 (1)	15 (1a)	0.0003 (1)	NA	NA
	Cadmium	--	--	4.29E-03 **	15 (4)	0.001 (1f)	NA	NA
	Lead	NA	NA	NA	NA	NA	NA	NA
	PCBs	2.20E-04 (1)	7.7 (1)	2.20E-03 **	7.7 (3r)	NA	NA	NA
Freon 113 Area@	Carbon Tetrachloride	4.29E-06 **	0.15 (4)	4.29E-05 **	0.15 (4)	0.0007 (1)	0.002 ++	0.00057 (3e)
	Chloroform	8.57E-07 **	0.03 (4)	2.30E-05 (1)	0.08 **	0.01 (1)	0.035 ++	0.01 (3r)
	Freon 113	--	--	--	--	30 (1)	30 (2)	8.57 **
	PCE	1.46E-06 **	0.05 (4)	1.46E-05 **	0.05 (4)	0.01 (1)	0.035 ++	0.01 (3r)
	TCE	1.46E-06 **	0.05 (4)	2.86E-06 **	0.01 (4)	0.006 (3e)	0.021 ++	0.006 (3r)
Parking Lot 3@	Carbon Tetrachloride	4.29E-06 **	0.15 (4)	4.29E-05 **	0.15 (4)	0.0007	0.002 ++	0.00057 (3e)
	Chloroform	8.57E-07 **	0.03 (4)	2.30E-05 (1)	0.08 **	0.01 (1)	0.035 ++	0.01 (3r)
	1,2-Dichloroethane (EDC)	2.60E-06 (1)	0.09 (1)	2.60E-05 (1)	0.09 (2)	NA	NA	NA
	TCE	1.46E-06 **	0.015 (4)	2.86E-06 **	0.01 (4)	0.006 (3e)	0.021 ++	0.006 (3r)

Footnotes:

1 U.S. EPA, November 1993, Integrated Risk Information System (IRIS).
2 U.S. EPA, March 1993, Health Effects Assessment Summary Tables (HEAST).
3 U.S. EPA Region IX, November 1993, Region IX Preliminary Remediation Goals (PRGs), Fourth Quarter 1993.
r: derived by route-to-route extrapolation
e: derived by U.S. EPA Environmental Criteria and Assessment Office (ECAO)
a: adjusted for absorption; arsenic inhalation = 30%.
f: toxicity value for consumption of cadmium in food.
4 California EPA, Office of Environmental Health Hazard Assessment, June 18, 1992, Memorandum on California Cancer Potency Factors.
5 Derived by extrapolation.
* For the purpose of this assessment, these PAHs were assumed to have the same toxicities as benzo[a]pyrene.
+ For the purpose of this assessment, California Cancer Potency Factors were given precedence over U.S. EPA Cancer Potency Factors if the California values were higher than the U.S. EPA values.
** Calculated using the following equations:
risk per ug/m^3 (air) = (risk per mg/kg-day) x 1/70 kg x 20 m^3/day x 10^{-3} mg/ug
risk per ug/L (water) = (risk per mg/kg-day) x 1/70 kg x 2 L/day x 10^{-3} mg/ug
++ Calculated using the following equation:
reference concentration (mg/m^3) = RfD (mg/kg-day) x 70 kg / 20 m^3/day
@ Chemicals in these areas are chemicals of potetial concern in groundwater (i.e., soil exposures are not a concern).

Under baseline conditions, the maximum HI value for noncarcinogenic risks in future on-site workers was 2.0 (from groundwater exposures in the Freon 113 Area). Under current conditions, the maximum HI value was reduced to 1.0 (from soil exposures at the Burn Pits). After cleanup occurs, the HI values for noncarcinogenic risks will be reduced to less than unity in all areas, indicating that noncarcinogenic effects are not likely to occur in workers or residents.

6.2 ENVIRONMENTAL RISKS

As part of the basewide RI/FS, the Army prepared an ecological risk assessment report. The main objective of the ecological assessment was to qualitatively evaluate the potential adverse effects of hazardous waste on the habitat at the Depot, including representative plant and animal species (receptors) observed in the habitat. Groundwater contaminants were not considered in the ecological assessment, since the most shallow groundwater aquifer is located approximately 80 feet below ground surface and does not recharge surface water bodies in the area. Ecological risks were evaluated for both baseline (no action) conditions and cleanup (remediated) conditions.

6.2.1 Habitat Description

The predominant habitat at SADA is disturbed annual grassland, which covers approximately 170 of the 485 acres at the site. The grassland at the Depot has been significantly degraded as a result of past agricultural practices, urban intrusion, and activities conducted at the Depot.

Approximately 0.52 acres at the Depot have been identified as jurisdictional wetlands according to the criteria in Section 404 of the Clean Water Act. The U.S. Army Corps of Engineers has determined that the proposed activities to fill the 0.52 acres of jurisdictional wetlands would result in minimal adverse impacts and is activity of a nature specifically authorized under both Nationwide Permits 26 and 38, as set forth in 33 CCR Part 330.

Two invertebrate species that are associated with vernal pools have been identified on the depot. These species are the vernal pool fairy shrimp *(Branchinecta lynchi)* and California linderiella *(Linderiella occidentalis)*. One of these species, the vernal pool fairy shrimp, was listed by the U.S. Fish and Wildlife Service (USFWS) as threatened under the Federal Endangered Species Act on September 15, 1994. One California black walnut tree *(Juglans hindsqi)*, which is listed by the California Native Plant Society as a rare, threatened, or endangered plant species, was also observed on the depot. In addition, the burrowing owl *(Athene cunicularia)*, which is considered a special animal species by the California Department of Fish and Game. No other State or Federal endangered and threatened species have been observed on the depot.

6.2.2 Ecological Effects Assessment

For the purpose of the ecological assessment, No Observed Adverse Effect Levels NOAELs) and/or Lowest Observed Adverse Effect Levels (LOAELs) were used as the criteria for assessing potential ecological effects from exposures to contaminants at the depot. The NOAELs are concentrations or doses of a chemical that produce no observable adverse effects in individuals of a species under a specific set of conditions, whereas the LOAELs are the lowest concentrations at which effects are observed. These toxicity values were selected as the toxicity criteria for this assessment because they are conservative and were therefore assumed to be protective of ecological health. If NOAELs or LOAELs were not available for specific chemicals or receptors, other toxicity data were used as indicators of potential ecological effects. A comparison of the NOAELs or LOAELs and the soil contaminant concentrations before and after cleanup is shown on Table 7.

6.2.3 Exposure Assessment

A total of eleven species observed at the Depot were selected as receptors for this assessment. The species were selected based on their occurrence, likelihood of contact with contaminants (considering home ranges and other factors), trophic level, and habitat suitability. The receptors include four avian (bird) species, three mammalian species, one amphibian, insects (*Arthropods*), earthworms (*Annelids*), and grassland vegetation.

Exposures to the vegetation (plants) growing in contaminated areas were assumed to occur through potential uptake of soil contaminants by the plant roots and translocation to other plant parts, or through potential uptake of contaminants in fugitive dust deposited on the plant foliage (e.g. leaves). Exposures to earthworms or insects residing in contaminated soil were assumed to occur by ingestion or direct absorption of contaminants in the soil. Exposures to the mammalian and avian receptors were assumed to occur mainly by ingestion of contaminated food sources or by dermal absorption (e.g. by burrowing animals).

Chemical uptakes/intakes were estimated for contaminants whose surface soil concentrations exceeded the toxicity values presented in Ecological Effects Assessment or for contaminants that are bioaccumulated by terrestrial organisms.

TABLE 7
ECOLOGICAL TOXICITY VALUES FOR CONTAMINANTS OF CONCERN
AT THE SACRAMENTO ARMY DEPOT

RECEPTOR SPECIES	Surrogate Receptor(s)	TOXICITY VALUES** Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Zinc	DDT	Dieldrin	Dioxins	Chrysene
Maximum Concentration at SAAD (mg/kg soil)*		8.8	449	465	314	302	8.7	1418	0.04	0.031	0.0009	0.315
Cleanup or Residual Concentration (mg/kg)		7.3 (background)	40	33 (background)	29 (background)	174	0.1 (background)	48.5 (background)	Removed (excav.)	Removed (excav.)	Removed (excav.)	Removed (excav.)
AVIAN RECEPTORS:												
Great Horned Owl *(Bubo virginianus)*	Barn Owl								3 ppm in diet[19] (repro. effects)	0.5 ppm in diet[19] (repro. effects)		
American Kestrel *(Falco platyrhynchos)*	–		0.24 ppm[3] (NOAEL for eggs of Cooper's Hawks)			10 mg/kg in diet[15] (NOAEL)			10 ppm in diet[24] (repro. effects) 5-8 ppm in eggs	3 ppm in diet[31] or 1-2 ppm in eggs (reduced survival repro.)		
Burrowing Owl *(Athene cunicularia)*	Barn Owl								3 ppm in diet[19] (repro. effects)	0.5 ppm in diet (repro. effects)		
Mallard *(Anas platyrhynchos)*	Ducks	500 mg/kg diet[1] (LD_{50})	20 ppm[5] (neuro. effects in ducklings) 4 ppm[5] (altered behavior)	10 ppm in diet[9] (reduced survival)			3 mg/kg diet[28] (neurol., repro. effects) 0.5 ppm in liver[29] (threshold)		10 ppm in diet[20] (repro. effects)	709 mg/kg[13] (LD_{50})		4000 mg/kg diet[27] (LOAEL)
Other Birds (Non-receptors):	–	33 mg/kg diet[1] of copper acetoarsenite (survival of Brown-headed Cowbirds)	75 mg/kg diet[31] (toxicity, Japanese Quail) 100 mg/kg kidney (threshold for toxicity)			500-1000 mg/kg diet[31] (LOAEL, Quail)	0.5 ppm in brain[23] or eggs (neuro/repro. effects)			25 mg/kg diet[13] (NOAEL, Japanese Quail)		
MAMMALIAN RECEPTORS:												
Coyote *(Canis latrans)*	Dogs	0.5 mg/kg-day[2] (NOAEL, anemia, neuro.)		6 ppm Cr^{6+}, in drinking water (NOAEL)[9]		4 mg/kg-day[16] (LOAEL, heme synth.)	0.1-0.25 mg/kg BW[23] (repro.)	4 mg/kg zinc glucomate[7] in diet (adverse effects)	16 mg/kg-day[22] (NOAEL, liver)	3 mg/kg diet [13] (0.075 mg/kg-day)		
Black-Tail Jack Rabbit *(Lepus californicus)*	Rabbits	4000-6000 mg/kg[1] (adverse effects by dermal exposure to cacodylic acid)	48 mg/kg[6] (proteinurea) 300 ppm[7] in drinking water (immunosuppression)	1,250 ppm diet[10] (NOAEL)			10 ppm mercuric Cl.[7] in drinking water (immunosupp.)		0.18 mg/kg-day[22] (LOAEL, thymus)		8 mg/kg-day[26] (lethal., dermal exp.)	
Rodents: California Ground Squirrel *(Spermophilus beecheyi)* Valley Pocket Gopher *(Thomomys bottae)* California Vole *(Microtus californicus)*	Mouse, rat, or shrew	39.4 mg/kg[1]	1 mg/kg-day[6] (NOAEL for proteinurea in rats) 305 mg/kg liver (damage, shrews)	2000 mg/kg-day[10] (NOAEL for all effects in rats)	7.9-130 mg/kg-da.[12] (NOAEL range in rats)	0.08 mg/kg/-day[16] (NOAEL, heme synth.)	0.7 mg/kg-day[18] (LOAEL, neuro.)		10 mg/kg-day[22] (NOAEL, repro.)	0.06 mg/kg-day[25] (NOEAL in rats, hepatic effects) 0.09 mg/kg-day[13] (LOAEL, mice)	0.001 ug/kg-day[26] (NOAEL in rats, liver tox. and cancer)	99 mg/kg diet[27] (cancer, rats)
Other Mammals (Non-receptors)			100 mg/kg kidney 200-300 mg/kg liver (threshold for toxicity)		12.9 mg/kg-day[12] (NOAEL, repro. in minks)			600 mg/kg kidney[32] (Toxicity, deer)				
AMPHIBIAN RECEPTORS: Pacific Tree Frog *(Hyla regilla)*	Frogs or other Amphibians	40 ug/L[1] (LC_{50}), Narrow-mouth toad embryos)	4 ug/L[30] (NOAEL, embryos)		0.06 mg/L[30] (growth red. in tadpoles)	0.6 mg/L[17] (neuro.)	2.4 ug/L[28] (LC_{50})	20-30 mg/L[30] (lethality, tadpoles)		0.5 mg/L[13] (8-day Survival, Toad	500 ug/kg[33] (NOAEL for metaorphoses in tadpoles)	5 mg BaP/kg[27]
INSECTS *(Arthropods)*	–	100-1000 mg/kg[1] diet (lethal., beetles); 21-31 mg/kg BW[1] (lethal., bees)				230 mg/kg (spiders, ants) 12,800 mg/kg[14] BW (woodlouse)		24,000 mg/kg soil [32]			4.2 ug/kg[33] (snails)	
EARTHWORMS *(Annelids)*	–	250 ppm in soil[3] (repro.)	710 ppm in soil[5] (red. survival)	62.3 ppm in soil[8]	60 mg/kg[8] (LOAEL)	147 mg/kg in soil[14]	10 mg/kg (red. BW)	617 mg/kg[14]			200 ug/kg[33] (red. repro.)	
GRASSLAND VEGETATION (Grasses, forbes, shrubs)	Various crops, grasses, shrubs, trees	25-85 mg/kg soil[1] (red. crop yield)	10-30 ppm in soil[4] (red. crop yield)	200 ppm (red. yield, agricultural plants)	69 ppm in root[11] tissue of plants (reduced yield)		10 ppm in soil (effects, non-speciated plants)	326 ppm in leaves[11] (red. yield, corn)				

* Greatest 95* UCL for sites of concern.
** UNITS: 1 ppm = 1 mg/kg (solids)
1 ppm = 1 mg/L (liquids)
LD_{50} = Dose at which lethality is observed in 50% of the study population.
LC_{50} = Concentration at which lethality is observed in 50% of the study population.
BW = Body Weight

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6.2.4 Risk Characterization

The risk characterization was conducted in two phases. The first phase was a screening evaluation in which the relative risk of each chemical was estimated by calculating the ratio of the surface soil concentration of the chemical to the NOAEL or LOAEL for the most sensitive receptor. For the screening evaluation, it was assumed that if the soil concentration of a contaminant exceeded the toxicity value for the most sensitive receptor, then there may be a concern for adverse effects in the receptor(s). This approach does not account for exposure factors such as the frequency of chemical intake, or the uptake (absorption) and/or bioaccumulation of chemicals by the receptors. These factors were considered in the second (refined) phase of the risk characterization for specific chemicals whose relative risk exceeded unity (1.0) or for chemicals that are likely to bioaccumulate in terrestrial organisms.

Results of the screening evaluation indicated that maximum baseline concentrations of chromium, copper, lead, and zinc at the depot may result in exposure levels which are greater than the NOAELs or LOAELs for plants and/or earthworms. However, soil contaminated by these metals will be removed (excavated) from contaminated areas at the depot and remediated by soil solidification, which will prevent exposures to ecological receptors such as the plants and earthworms.

The second (refined) phase of the risk characterization was performed for cadmium and the organochlorine chemicals (DDT, dieldrin, and dioxins) because these chemicals bioaccumulate in terrestrial organisms, which increases the potential for exposures to receptors in the higher trophic levels. In the second phase of the risk characterization, the potential biomagnification of cadmium and the organochlorine pesticides was estimated for secondary and tertiary consumers (receptors), respectively.

Using biomagnification factors of 2.5 and 20 for cadmium and DDT, respectively, it was concluded that maximum cadmium concentrations at the depot are unlikely to result in liver concentrations associated with toxicity in secondary or tertiary consumers, whereas maximum DDT concentrations at the depot may result in residual concentrations in the eggs of American Kestrels that are associated with eggshell thinning. However, exposures to American Kestrels may be over-estimated in this assessment because organisms in the lower trophic levels (e.g., plants) were assumed to take up 100% of the DDT in soil (a conservative assumption).

TABLE 8
SURVIVING SUB-ALTERNATIVES FOR DETAILED ASSESSMENT

AREA OF CONTAMINATION	SUB-ALTERNATIVE NO. 1	SUB-ALTERNATIVE NO. 2	SUB-ALTERNATIVE NO. 3	SUB-ALTERNATIVE NO. 4	SUB-ALTERNATIVE NO. 5
South Post Groundwater	No Further Action (Continue pumping at current flowrate using existing GW extraction system)	Extraction at an Increased Flowrate Using Existing Extraction System; (Increase Flow Rate to a Maximum of 450 GPM)	Extraction Using Existing Extraction System; Add one vertical and two horizontal Extraction Wells.	Extraction Using Existing Extraction System; Add one vertical and two horizontal Extraction Wells; Zone C Extraction Well.	Extraction Using Existing Extraction System; Add perimeter Off-site Extraction Wells; Air Sparge & Soil Vent; Zone C Extraction Well.
Parking Lot 3 Groundwater	No Further Action	Pump from two vertical Extraction Wells / Treat Groundwater in the South Post Groundwater Treatment Plant.	Pump from two vertical Extraction Wells / Discharge through carbon filter to sewer.	-------	-------
Building 300 Burn Pit Soil	No Action	Capping	Excavate / Stabilize / On-site Disposal (in-place)	Excavate / Stabilize / On-site Disposal (CAMU)	-------
Battery Disposal Well Investigation - Derived Waste (Soil)	Off-site Disposal	Consolidate / Stabilize / Onsite Disposal (CAMU)	-------	-------	-------
All Other Sites*	No Action or No Further Action	-------	-------	-------	-------

NOTE:
*All other sites include areas addressed as Operable Unit RODs and no action/no further action sites listed in Table 1.

Furthermore, soil contaminated by DDT at the depot will be excavated and remediated, which will prevent exposures to ecological receptors.

The results of the ecological assessment also indicated that the cleanup (remediation) goals for soil at the depot are protective of the health of ecological receptors.

7 DESCRIPTION OF ALTERNATIVES

A basewide feasibility study was conducted to develop remediation alternatives for the identified areas of contamination (AOCs) at the depot. These areas include:

- South Post Groundwater
- Parking Lot 3 Groundwater
- Building 300 Burn Pit Soil
- Battery Disposal Well Investigation-Derived Waste (Soil)

Sub-alternatives were assembled for each AOC from applicable remediation technologies and process options. The sub-alternatives were initially evaluated for effectiveness, institutional implementability, and cost. Sub-alternatives surviving the initial screening process are presented in Table 8. These sub-alternatives were then evaluated by comparing them to the nine criteria required by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The remediation sub-alternatives emphasize the use of technologies which reduce toxicity, mobility, or volume (TMV) of contaminants, and which provide a permanent solution. In addition to the remediation sub-alternatives, the NCP and CERCLA require that a no-action sub-alternative be considered for every AOC. The no-action sub-alternative serves primarily as a point-of-comparison for other sub-alternatives. The sub-alternatives evaluated for each AOC are described in more detail below.

7.1 SOUTH POST GROUNDWATER

Each sub-alternative would be applied to remediate approximately 1,106 million gallons of water in the A/B Zone aquifer and approximately 110 million gallons in the C Zone aquifer. Groundwater in this area is impacted by trichloroethene (TCE), cis-1,2-dichloroethene and 1,2-dichloroethane. The mass of contaminants in the groundwater is estimated to be 23.6 pounds or approximately 4 gallons.

7.1.1 Sub-Alternative 1 - No Further Action

This sub-alternative consists of continued extraction of groundwater in the South Post area using the existing groundwater extraction and treatment system, as set forth previously in the Interim OU ROD. The system was designed in 1988 and has been operating since November of 1989.

The existing extraction system for the South Post area consists of one extraction well located at the source area, and six extraction wells located along the southwestern boundary of SADA in a "fence" arrangement to act as a hydraulic barrier. The wells extract water from both the A and B Zone aquifers. The total maximum flow rate from the extraction system is 360 gallons per minute (GPM) and the system currently runs at an average flow rate of 312 GPM. The concentrations of VOCs in the South Post area groundwater have steadily decreased over time. Currently, two constituents, TCE and cis-1,2-DCE still exceed the FRGs. The extent of these contaminants above the FRG is shown on Plates 7, 8, 9 and 10.

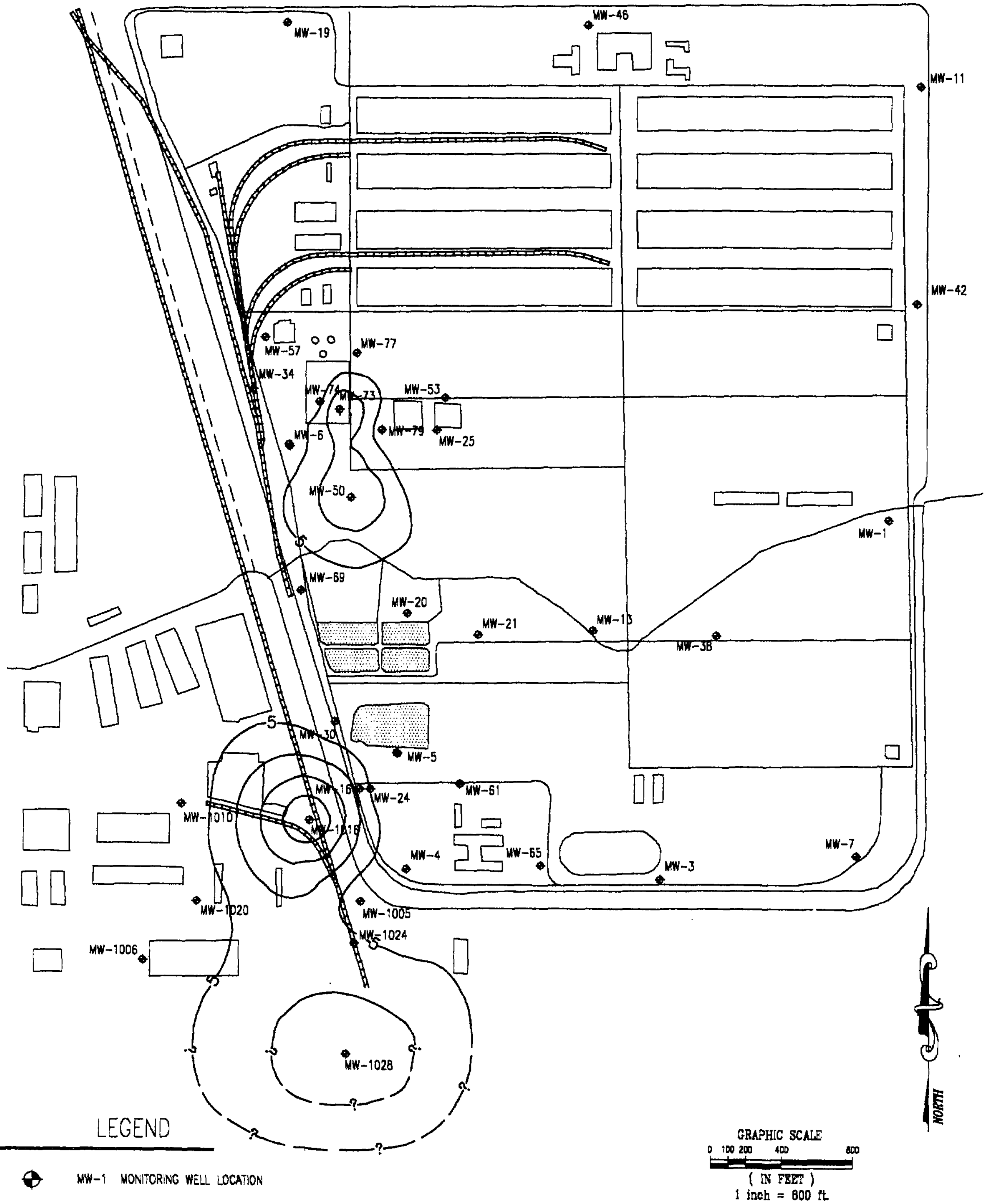
Groundwater is pumped from each extraction well through a double-contained PVC carrier pipe into the influent surge tank of the South Post Groundwater Treatment Plant (SPGWTP). The groundwater is pumped through an ultraviolet radiation (UV)/chemical oxidation treatment unit. Hydrogen peroxide (H_2O_2) is the chemical oxidant. The treated water is pumped through a 6-inch PVC force main to a sanitary sewer manhole off-site. The sanitary sewer authority is the Sacramento Regional Sanitation District.

A water reuse study (Kleinfelder, October 1990) was prepared to evaluate in detail the possible reinjection or alternative uses of the water. The study found that off-depot uses and reinjection of the water were not feasible. On-depot uses were recommended, including irrigation and industrial use. Accordingly, a water reuse station was built to facilitate on-depot reuse. Water not reused, which is the majority of the water, continues to be discharged to the sanitary sewer.

The UV/H_2O_2 treatment unit can provide 360 KW of UV energy from 24 15-KW medium pressure mercury lamps. Lamps are operated in pairs from 2 to 12 lamps for each of the two chambers depending on the treatment levels needed for the influent flowrate. Hydrogen peroxide is injected immediately upstream of the treatment unit from a 300-gallon tank of 50 percent H_2O_2. The H_2O_2 injection rate is adjusted manually over a wide range of flowrates. At this time the water is pretreated to at least MCLs prior to discharge.

Under this sub-alternative, operation of the existing extraction system would be maintained at its current average flowrate (312 GPM). No further remedial actions would be implemented.

The greatest potential risks to human health or the environment from exposure to groundwater at the South Post Area are the possible ingestion and/or inhalation of vapors from the contaminated groundwater by humans, should a new drinking water well be installed into contaminated water. Currently, the contaminated groundwater is not being used for domestic (household) or industrial

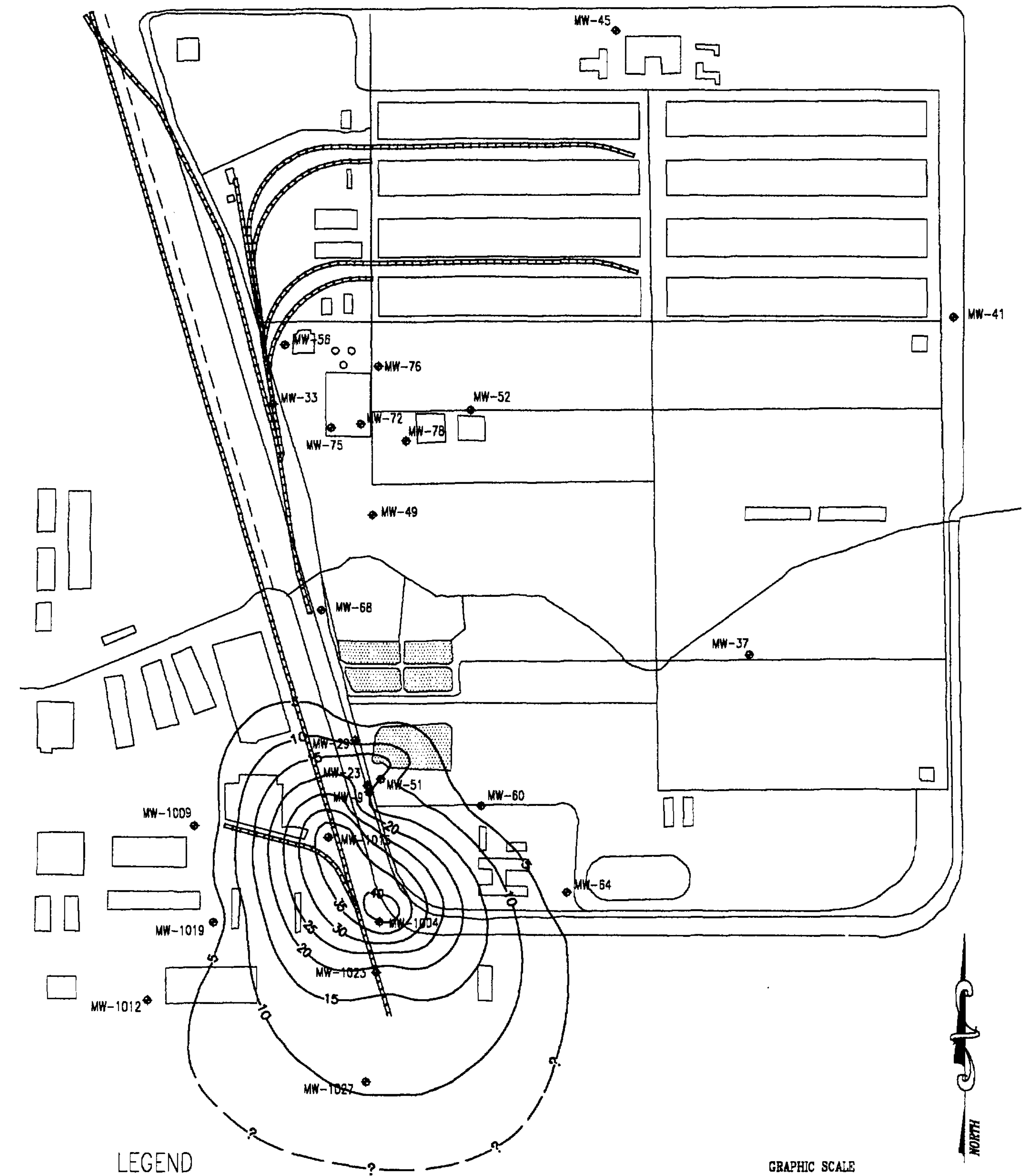


LEGEND

MW-1 MONITORING WELL LOCATION

5 µg/L TCE ISOCONCENTRATION CONTOURS A - ZONE
(CONTOUR INTERVAL = 5.0 ug/L)

KLEINFELDER		TCE ISOCONCENTRATION CONTOURS A - ZONE (4/94 THROUGH 8/94) SACRAMENTO ARMY DEPOT	PLATE 7
DRAWN BY: L.D./B.W.	DATE: 12-29-94		
PROJECT No. 24-150035-H05	DWG No. 35H05-01		



LEGEND

MW-1 MONITORING WELL LOCATION

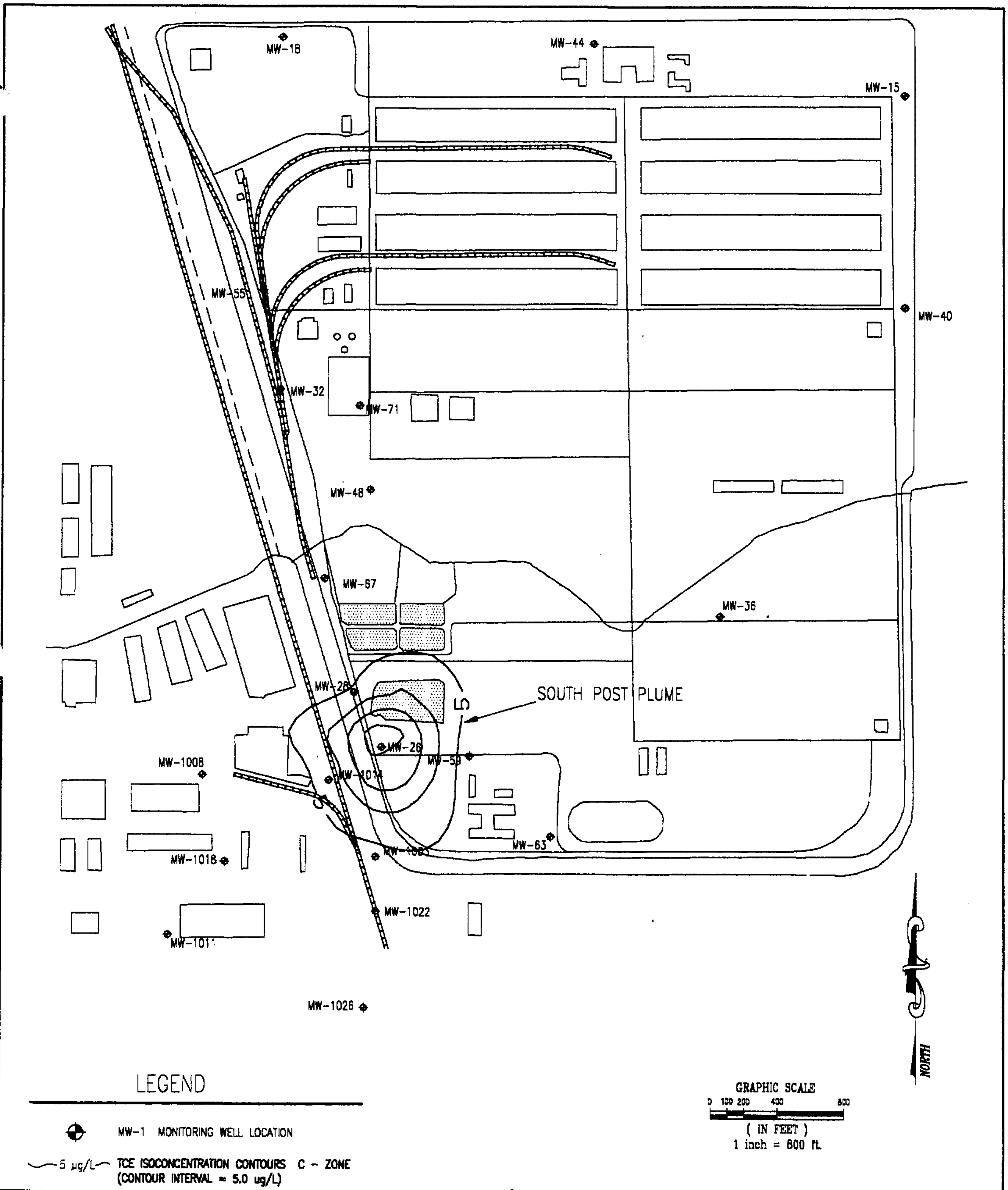
5 µg/L TCE ISOCONCENTRATION CONTOURS B - ZONE
(CONTOUR INTERVAL = 5.0 ug/L)

KLEINFELDER

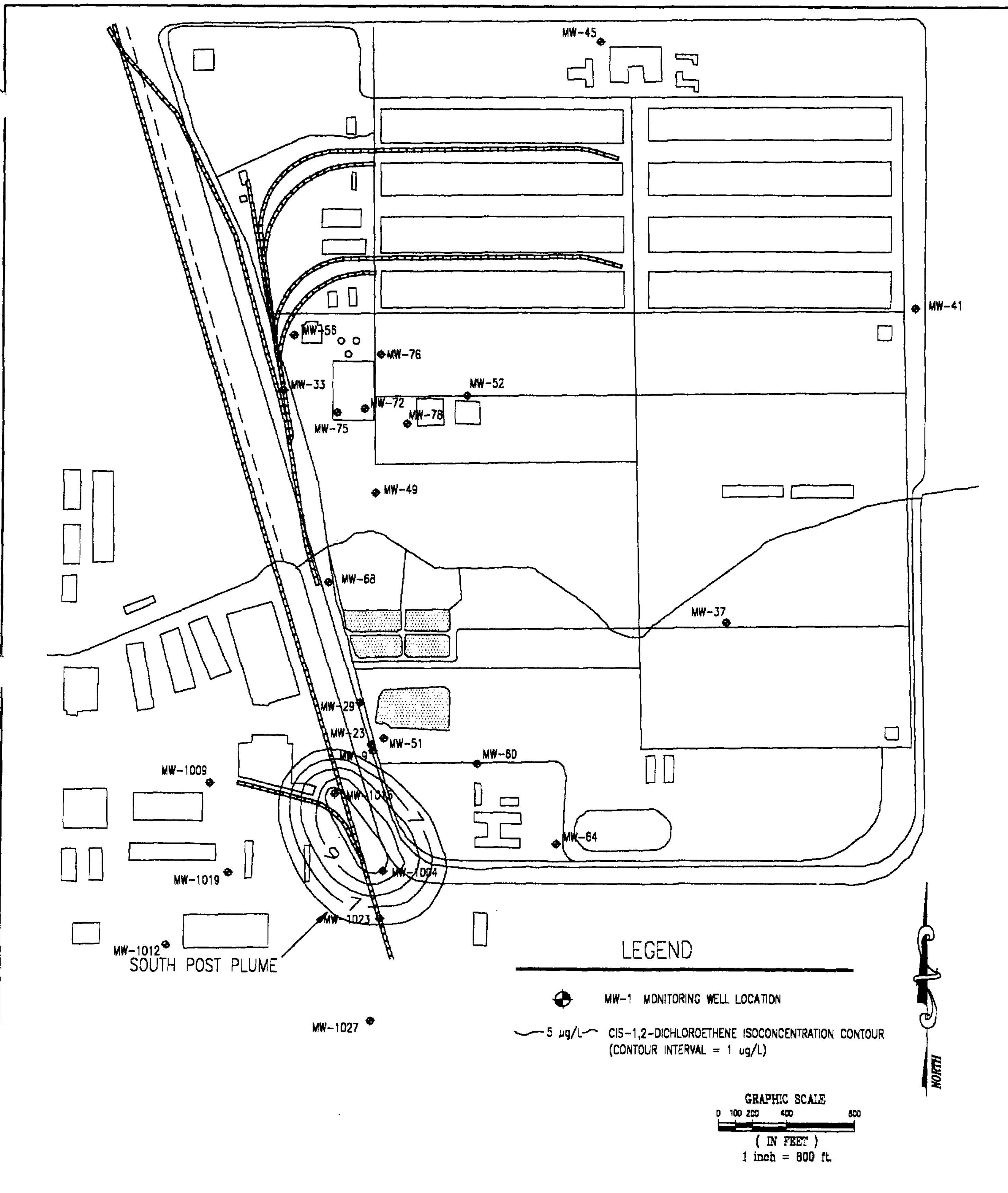
DRAWN BY:	L.D./B.W.	DATE:	12-29-94
PROJECT No.	24-150035-H05	DWG No.	35H05-02

TCE ISOCONCENTRATION CONTOURS
B - ZONE
(4/94 THROUGH 8/94)
SACRAMENTO ARMY DEPOT

PLATE
8



KLEINFELDER		TRICHLOROETHENE (TCE) EXCEEDING FRG IN ZONE – C (4/94 THROUGH 8/94)	PLATE
DRAWN BY: L.D./B.W.	DATE: 12-29-94		9
PROJECT No. 24-150035-H05	DWG No. 35H05-03	SACRAMENTO ARMY DEPOT	



KLEINFELDER

DRAWN BY: L.D./B.W.	DATE: 12-29-94	CIS -1, 2 - DICHLOROETHENE EXCEEDING FRG IN ZONE B (4/94 THROUGH 8/94)	PLATE 10
PROJECT No. 24-150035-H05	DWG No. 35H05-09	SACRAMENTO ARMY DEPOT	

purposes. If the groundwater was used for these purposes, however, this sub-alternative would be protective of human health by reducing groundwater contaminant concentrations to below the final remediation goals (FRGs). Reducing groundwater contaminant concentrations to FRGs results in maximum cancer and non-cancer risk levels for potential future residents of approximately 2×10^{-5} and 0.3, respectively. Furthermore, maximum cancer and non-cancer risk levels for potential future workers exposed to groundwater at the site would be approximately 1×10^{-5} and 0.15, respectively. These risk levels are within the risk level ranges that are generally acceptable to the U.S. EPA for Superfund sites.

Groundwater flow and chemical transport have been modeled for the remediation studies under current conditions and under several possible future pumping scenarios (Kleinfelder, 1994). The conclusions reached for each sub-alternative are based, in part, on these studies. This sub-alternative will remediate groundwater contaminants by gradually drawing about 90% of the plume area back on-base. The remaining plume will be so close to the FRGs that FRGs will be easily achieved by degradation of the contaminants.

This sub-alternative will reduce the concentrations of chlorinated volatile organic contaminants in groundwater and control the mobility of the plume in the following ways:

- VOCs at the South Post Burn Pits have been remediated under an Operable Unit Record of Decision. This remediation has removed the source of VOCs for groundwater in the South Post area.

- Groundwater will be maintained under a hydraulic gradient in Zones A and B, stalling additional migration of contaminants further off-base. Contaminants will gradually migrate back toward the base, or degrade.

- Pumping of the contaminated water removes constituents from the subsurface, thereby reducing the mass of constituents remaining in the groundwater.

This sub-alternative will not pump groundwater directly from Zone C. However, the extraction of groundwater from Zone C will occur due to the gradient created by pumping from overlying Zones A/B. Zone C will be cleaned up through extraction from Zones A/B.

For the extracted groundwater, the South Post Groundwater Treatment System oxidizes the organic compounds by direct photolysis and by catalyzing the chemical oxidation from H_2O_2 and hydroxyl radicals, which form as a result of the interaction of UV radiation and H_2O_2. The products of the oxidation are carbon dioxide, water, and mineral salts, such as chloride. The system produces no residuals and has functioned well for five years.

In summary, the groundwater component of this sub-alternative is protective of human health and the environment. The groundwater plume is controlled and contaminant concentrations will slowly be reduced to below FRGs (MCLs). Based on the groundwater modeling, the estimate of time to achieve complete remediation for the groundwater component is 21 years.

This subalternative may not comply with state ARARs because it has not been demonstrated that all contaminated groundwater will be remediated to the groundwater cleanup standard.

7.1.2 Sub-Alternative 2 - Groundwater Extraction Using Existing System / Increase Flowrate to 450 GPM (Maximum)

This sub-alternative is the same as sub-alternative 1 above, except groundwater is extracted and treated at a higher flowrate and pumping is disproportionately increased in the southernmost wells. The existing groundwater treatment system will be modified to accept up to a 450 GPM flowrate. Modeling studies indicate that this alternative will capture the entire contaminant plume.

The modified UV/H_2O_2 groundwater treatment unit will have the capacity to accept a total of 450 gpm. The additional treated water will be added to the effluent of the existing South Post Groundwater Treatment System.

The performance of the SPGWTP was evaluated in detail after two years of operation. The efficiency and operating costs were evaluated for a range of operating parameters. Due to a significant decrease in the influent concentrations of TCE and other constituents, the destruction capacity of the existing SPGWTP will remain very high at the higher 450 gpm influent flowrate to the treatment plant. Current recommended operating settings are two lamps per chamber for a power dosage of 0.17 KW/gpm. At 450 gpm, dosage will increase to four lamps per chamber or 0.27 KW/gpm.

The current flowrate capability of the SPGWTP was reviewed last year. A finding was made that the system could be upgraded to 450 gpm at low cost by including new pump impellers and a new three-way valve with a higher flow coefficient. This is an efficient and cost effective upgrade to increase the pace of remediation through a higher pumping rate. The existing discharge line capacity was reviewed and found to be adequate for 450 gpm with a flow velocity of 5 feet per second.

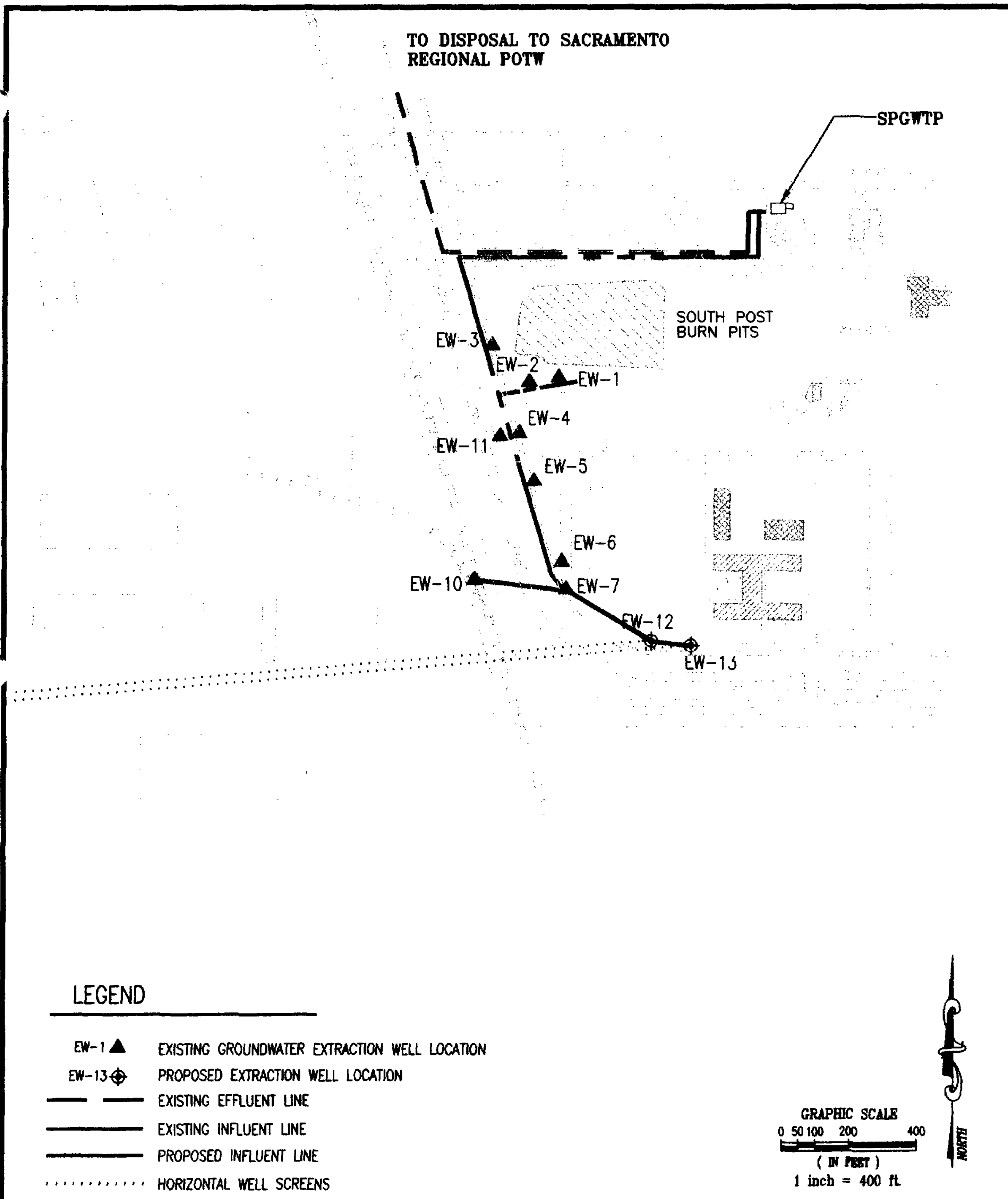
This sub-alternative is protective of human health and the environment for the same reasons as those of sub-alternative 1 above. Furthermore, protection will be achieved more quickly using this sub-alternative because contaminants will be removed at a faster rate. It is estimated, based on GW modeling data, that remediation will be achieved in 12 years in Zones A and B. Zone C will then degrade over the next 15 years.

The Army believes that this sub-alternative complies with ARARs because it has been demonstrated that all contaminated groundwater would be remediated to the cleanup standard as listed in Table 10 (See Section 9). However, the state RWQCB disagrees.

7.1.3 Sub-Alternative 3 - Increased System Flowrate/Off-Base Extraction Wells

This sub-alternative adds to the previous sub-alternative by pumping from additional off-base extraction wells. Pumping from the existing groundwater extraction system will be maintained and extraction from additional wells will be implemented to more rapidly capture the entire contaminant plume. The existing treatment plant will be modified to accept up to a 450 gpm flowrate (total). Pumping from each well will be adjusted for optimum contaminant recovery with the total pumping rate not exceeding 450 gpm. Contamination in the Zone C aquifer may be captured by the upward gradient induced by the pumping from Zones A/B.

A new offsite extraction well, EW-10, was recently installed as a pilot well for design purposes, but has not been activated. EW-10 is located southwest of the South Post Burn Pits, across from existing extraction well EW-7, near the property boundary. This sub-alternative will incorporate EW-10 into the current extraction system to recover contaminated groundwater from aquifer Zones A and B. Detailed design will be completed at a later date for the off-base wells. Currently, the Army plans to install two horizontal extraction wells (EW-12 and EW-13) south of the South Post Burn Pits and west of the U.S. Naval and Marine Corps Reserve Training Center. These wells will extend west to more rapidly capture contaminated groundwater which has migrated off-base. EW-12 and EW-13 will have screen lengths of approximately 750 to 800 feet and will have horizontal screen depths of 100 and 125 feet below ground surface, respectively. Conceptual locations of existing wells and proposed wells are shown on Plate 11.



LEGEND

EW-1 ▲	EXISTING GROUNDWATER EXTRACTION WELL LOCATION
EW-13 ⊕	PROPOSED EXTRACTION WELL LOCATION
— —	EXISTING EFFLUENT LINE
——	EXISTING INFLUENT LINE
——	PROPOSED INFLUENT LINE
············	HORIZONTAL WELL SCREENS

KLEINFELDER		ADDITIONAL EXTRACTION WELL LOCATIONS SOUTH POST GROUNDWATER SACRAMENTO ARMY DEPOT	PLATE 11
DRAWN BY: LD	DATE: 2-21-95		
PROJECT No. 24-150029-A51	DWG No. 0100B011		

Groundwater extracted from the three new wells will be pumped to the SPGWTP for treatment. The modified UV/H_2O_2 groundwater treatment unit will have the capacity to accept a total of 450 gpm. The additional treated water will be added to the effluent of the South Post Groundwater Treatment System.

This sub-alternative will protect human health and the environment in the same ways as sub-alternative 1. However, the extraction of groundwater from off-base wells, in addition to the seven existing wells, will reduce the time necessary to reach FRGs. It is estimated from modeling of the groundwater aquifer that remediation will be achieved under this sub-alternative in 8 years.

The Army believes that this sub-alternative complies with ARARs because it has been demonstrated that all contaminated groundwater would be remediated to the cleanup standards, as listed in Table 10 (See Section 9). However, the state RWQCB disagrees.

7.1.4 Sub-Alternative 4 - Increased System Flowrate/Off-Base Extraction Wells/Zone C Extraction

This sub-alternative is the same as sub-alternative 3, except groundwater is extracted from the Zone C aquifer. Pumping from Zone C will more rapidly and more positively capture the contamination detected in this deeper aquifer. Zone C extraction will be accomplished by pumping from existing well EW-11, which was installed as a pilot test well for design purposes. EW-11 has not been activated. It is located just north of existing extraction well EW-4. Groundwater extraction from the seven existing wells, the off-base wells (EW-10, EW-12 and EW-13) and the Zone C well (EW-11) will be optimized for maximum recovery with the total pumping rate not exceeding 450 GPM.

This sub-alternative will protect human health and the environment in the same ways as sub-alternative 1 above. However, the extraction of groundwater from three additional Zone A/B wells added to the seven existing wells, and the extraction from Zone C will further reduce the time necessary to reach FRGs. It is estimated from modeling of the groundwater aquifer that remediation of the South Post groundwater plume will be achieved in 9 years. Zone C will be pumped slowly over four years to achieve FRGs within the same time frame. The Zone C pumping rate must be controlled to avoid disruption of the A/B Zone pumping.

This sub-alternative will comply with ARARs.

7.1.5 Sub-Alternative 5 - Increased System Flowrate / Six Additional Off-site Extraction Wells / Zone C Extraction / Air Sparging and Soil Venting at Highest Contamination

In addition to the continued operation of the existing groundwater extraction and treatment system and the extraction of groundwater from Zone C, this sub-alternative includes the installation of six off-site extraction wells and the implementation of air sparging/soil venting at the South Post Area. Air sparging, and associated soil venting, would be conducted in the region of higher VOC concentrations in aquifer Zones A and B. This will reduce the time needed to reach remediation objectives in the higher concentration zone. The six off-site extraction wells will be optimally placed for rapid and efficient recovery of the remaining lower VOC contaminated plume. Vertical wells are needed to place around the air sparging system.

The selected area for sparging is based on the concept of reducing the higher concentrations quickly to further facilitate protectiveness of the remediation sub-alternative. Evaluation of the contaminant plume indicates that sparging of areas of the A/B aquifer zone with TCE above 30 ug/l will provide the best combination of removal through sparging and pumping.

A total of 8 horizontal remediation wells will be placed on-site and off-site in the South Post area. The remediation wells will be dual completion air sparging, soil venting wells. The wells will be connected to a blower capable of producing clean, compressed air for sparging of the subsurface. The vent system will sweep vapor from above the water table, capturing the sparge air and constituents. The vent wells will be connected to a negative pressure blower.

An air emission control device will be required. Activated carbon is effective at controlling TCE air emissions and has already been selected at two other operable units at SADA for air emission control where TCE is the primary air pollutant of concern. This sub-alternative will assume the use of activated carbon for air emissions control at the South Post Area air sparging system.

Six groundwater extraction wells will be placed in a semi-circular pattern along the western and southern edges of the area having higher VOC concentrations (above 30 ug/l). After sparging operations have been completed, the six extraction wells will capture the remaining (dilute) plume. The dilute plume to the north and east of the remediated area will be captured by the existing on-site wells (EW-1 through EW-7). All wells will have a total combined flowrate of 450 GPM.

This sub-alternative is protective of human health and the environment. Protection is achieved in the same ways as sub-alternative 1. The implementation of air sparging at the South Post area will accelerate volatile contaminant removal from the groundwater in the region of higher VOC concentrations. Additionally, the rapid removal of contaminants above Zone C will remove the source of this contamination, allowing pumping from Zone C to proceed more rapidly. Protection of human health and the environment will be achieved more quickly than with sub-alternatives 1 through 4. It is estimated that this alternative will achieve remediation in 9 years.

Implementation of this sub-alternative at the South Post Area will require a substantial amount of off-site construction. Permission for off-site access will need to be acquired from surrounding landowners. The installation of off-site remediation wells (sparge and vent wells) and groundwater extraction wells could be potentially disruptive and may be challenged by off-site owners. The spacing of sparge wells is critical to project success. This will make it difficult to relocate wells to reduce impacts. There is no assurance that access permission can be achieved for the large number of wells which would be installed under this sub-alternative. Additionally, substantial safety measures will be required during implementation. Large volumes of cuttings and development water will need to be covered, treated, and properly disposed.

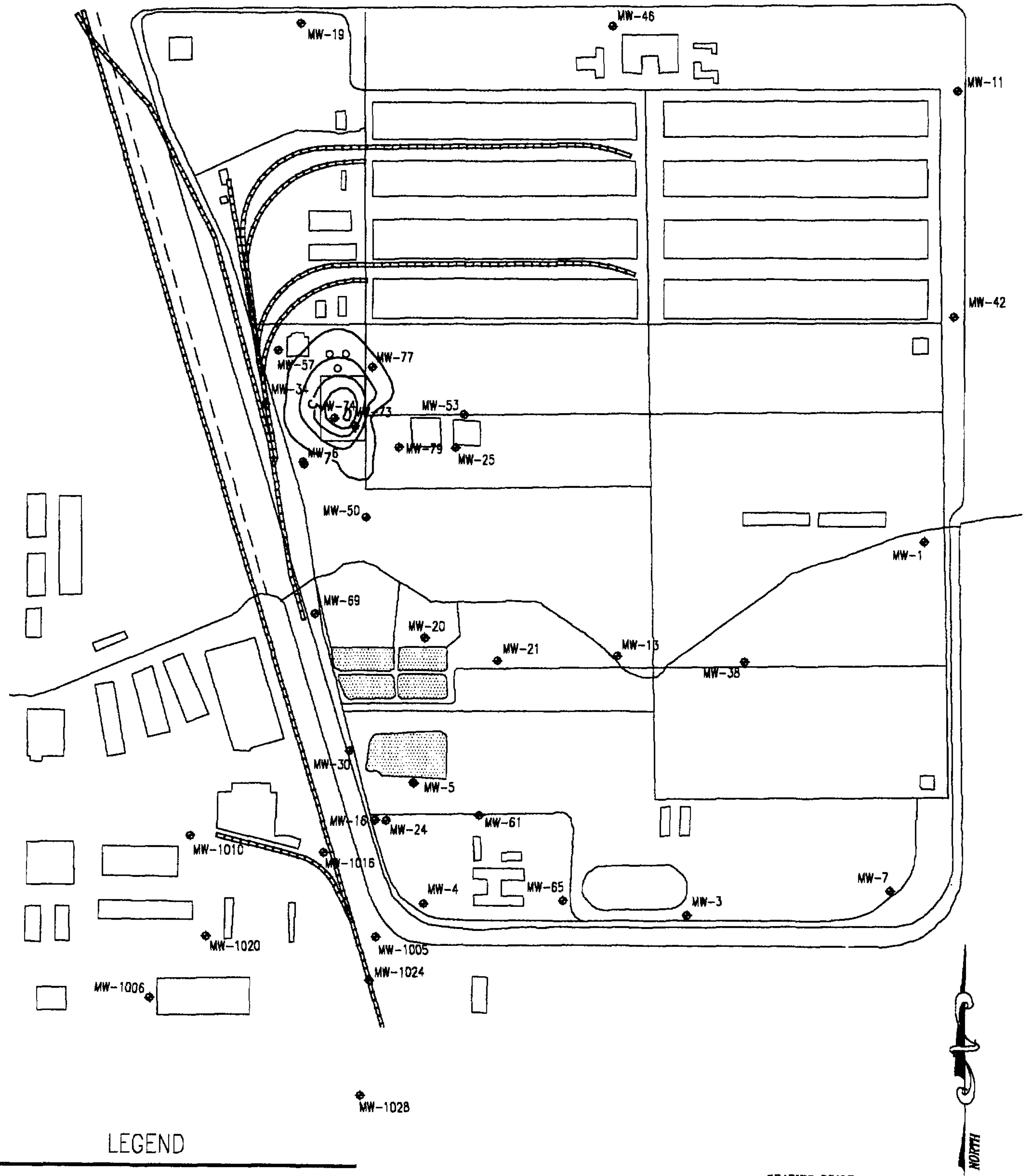
This sub-alternative will comply with ARARs.

7.2 PARKING LOT 3 GROUNDWATER

Each sub-alternative would be applied to remediate approximately 117 million gallons of water in the A/B Zone aquifer at Parking Lot 3. Groundwater in this area is impacted by carbon tetrachloride, trichloroethene (TCE), tetrachloroethene (PCE) and 1,2-dichloroethane. The mass of contaminants in the groundwater is estimated to be 0.54 pounds. The extent of these contaminants exceeding FRGs is shown on Plates 7-10 and Plates 12-16.

7.2.1 Sub-Alternative 1 - No Further Action

Under this sub-alternative, groundwater at Parking Lot 3 would remain at its current condition. Contaminant concentrations remaining in the groundwater after the air sparging pilot test would be allowed to degrade and naturally attenuate until FRGs (MCLs) are met. Contours of groundwater contaminants exceeding the FRGs are shown on Plates 12 through 16. In addition, chromium in MW-74 currently exceeds the MCL for chromium. Chromium has been detected at up to 70 ug/L. The MCL is 50 ug/L.



LEGEND

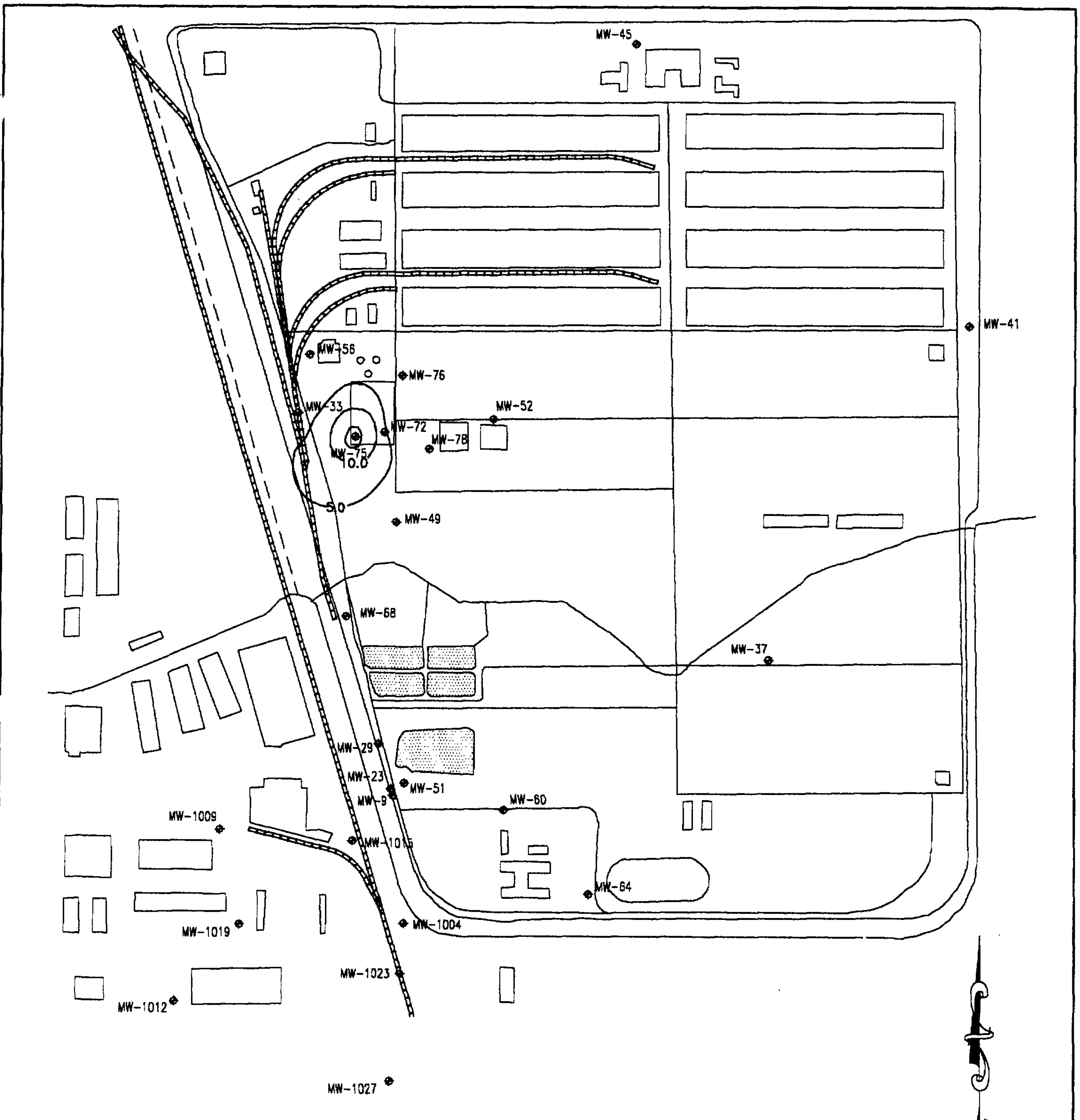
MW-1 MONITORING WELL LOCATION

5 ug/L PCE ISOCONCENTRATION CONTOURS A - ZONE (CONTOUR INTERVAL = 1.0 ug/L)

GRAPHIC SCALE
0 100 200 400 800
(IN FEET)
1 inch = 800 ft.

KLEINFELDER

DRAWN BY: L.D./B.W.	DATE: 12-29-94	PCE ISOCONCENTRATION CONTOURS A - ZONE (4/94 THROUGH 8/94) SACRAMENTO ARMY DEPOT	PLATE 12
PROJECT No. 24-150035-H05	DWG No. 35H05-04		



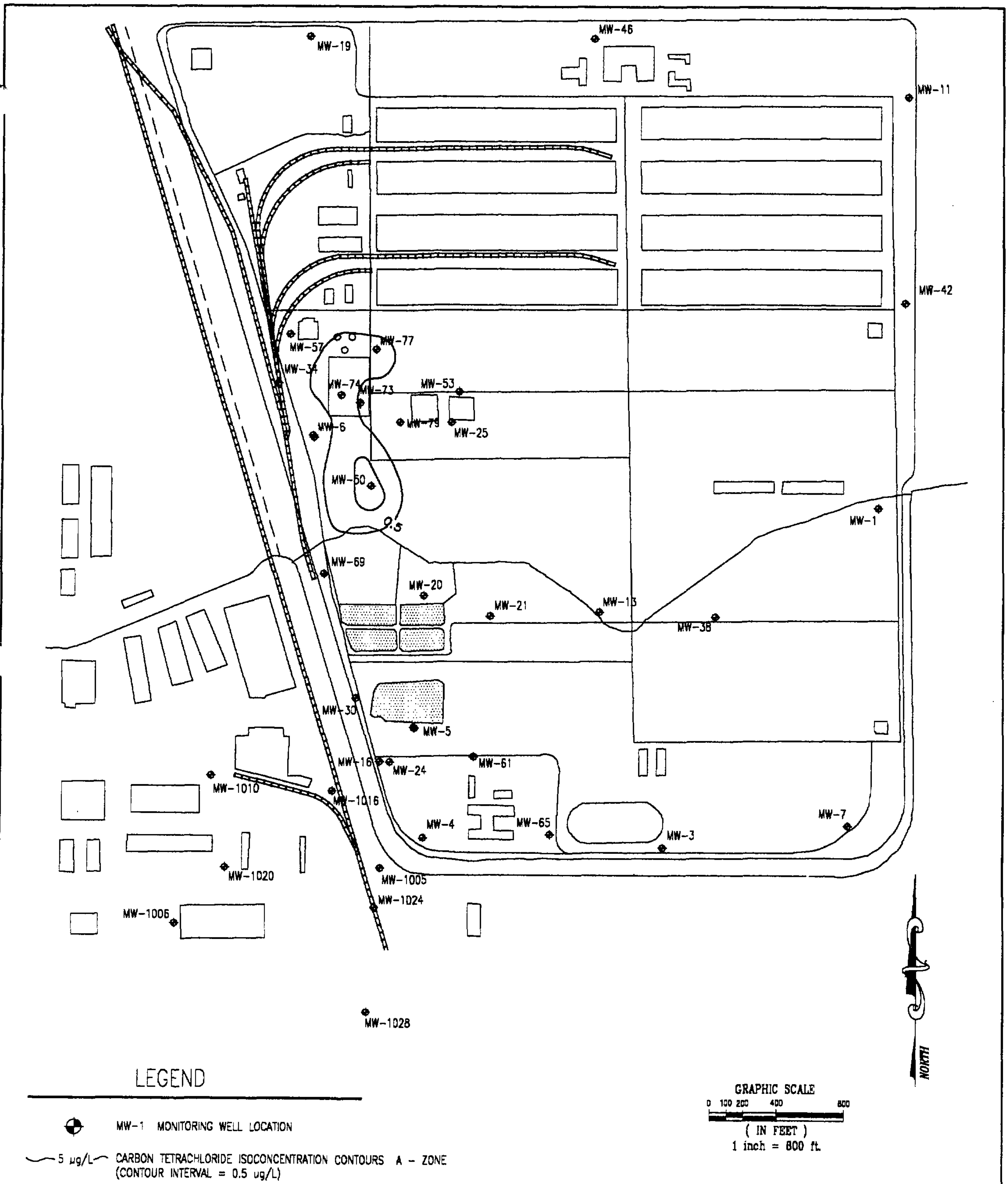
LEGEND

MW-1 MONITORING WELL LOCATION

5 μg/L PCE ISOCONCENTRATION CONTOURS – B ZONE
(CONTOUR INTERVAL = 5.0 ug/L)

GRAPHIC SCALE
0 100 200 400 800
(IN FEET)
1 inch = 800 ft.

KLEINFELDER		PCE ISOCONCENTRATION CONTOURS B – ZONE (4/94 THROUGH 8/94) SACRAMENTO ARMY DEPOT	PLATE 13
DRAWN BY: L.D./B.W.	DATE: 12-29-94		
PROJECT No. 24-150035-H05	DWG No. 35H05-05		

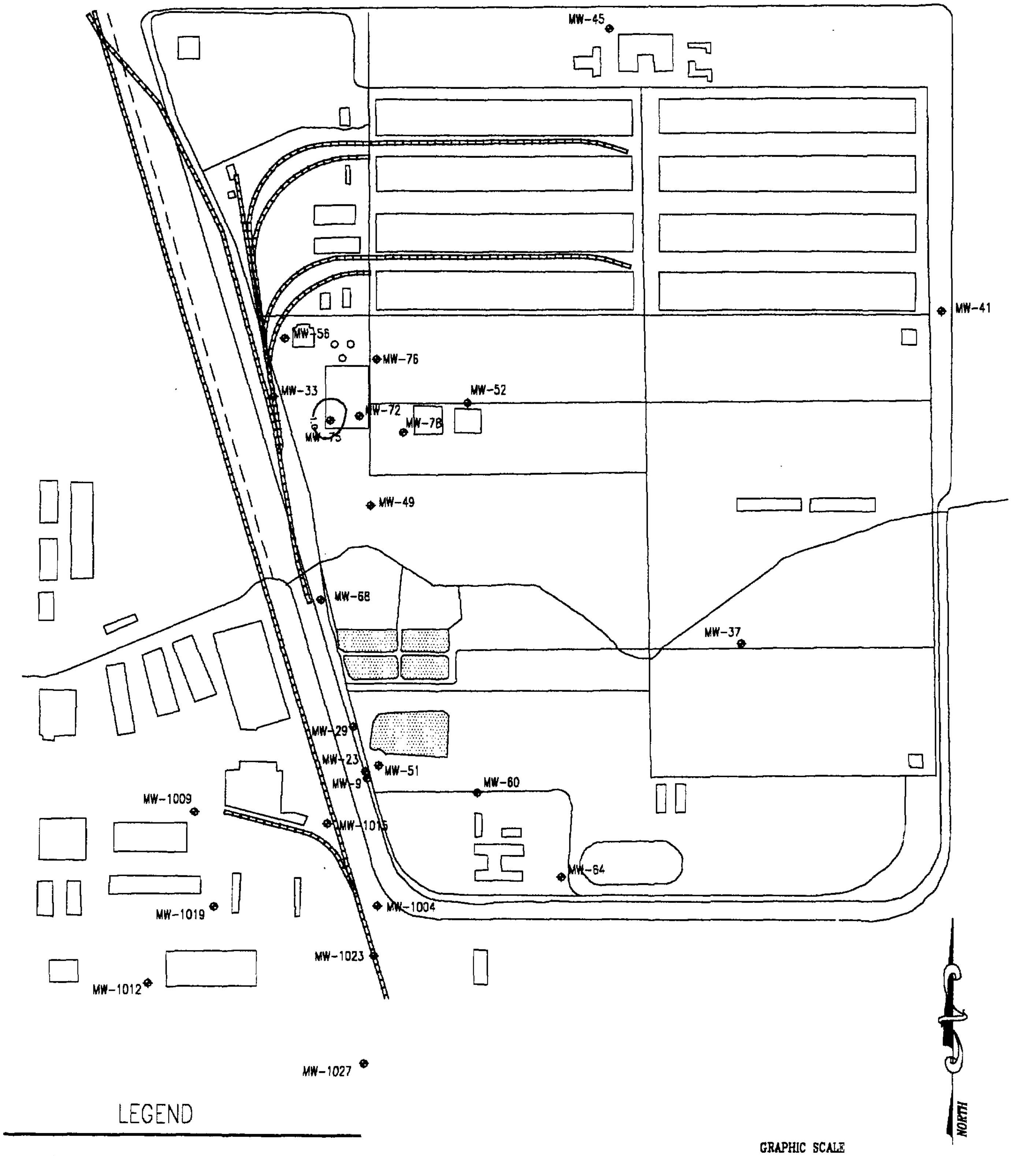


KLEINFELDER

CARBON TETRACHLORIDE
ISOCONCENTRATION CONTOURS
A - ZONE (4/94 THROUGH 8/94)
SACRAMENTO ARMY DEPOT

PLATE 14

DRAWN BY: L.D./B.W.	DATE: 12-29-94
PROJECT No. 24-150035-H05	DWG No. 35H05-06

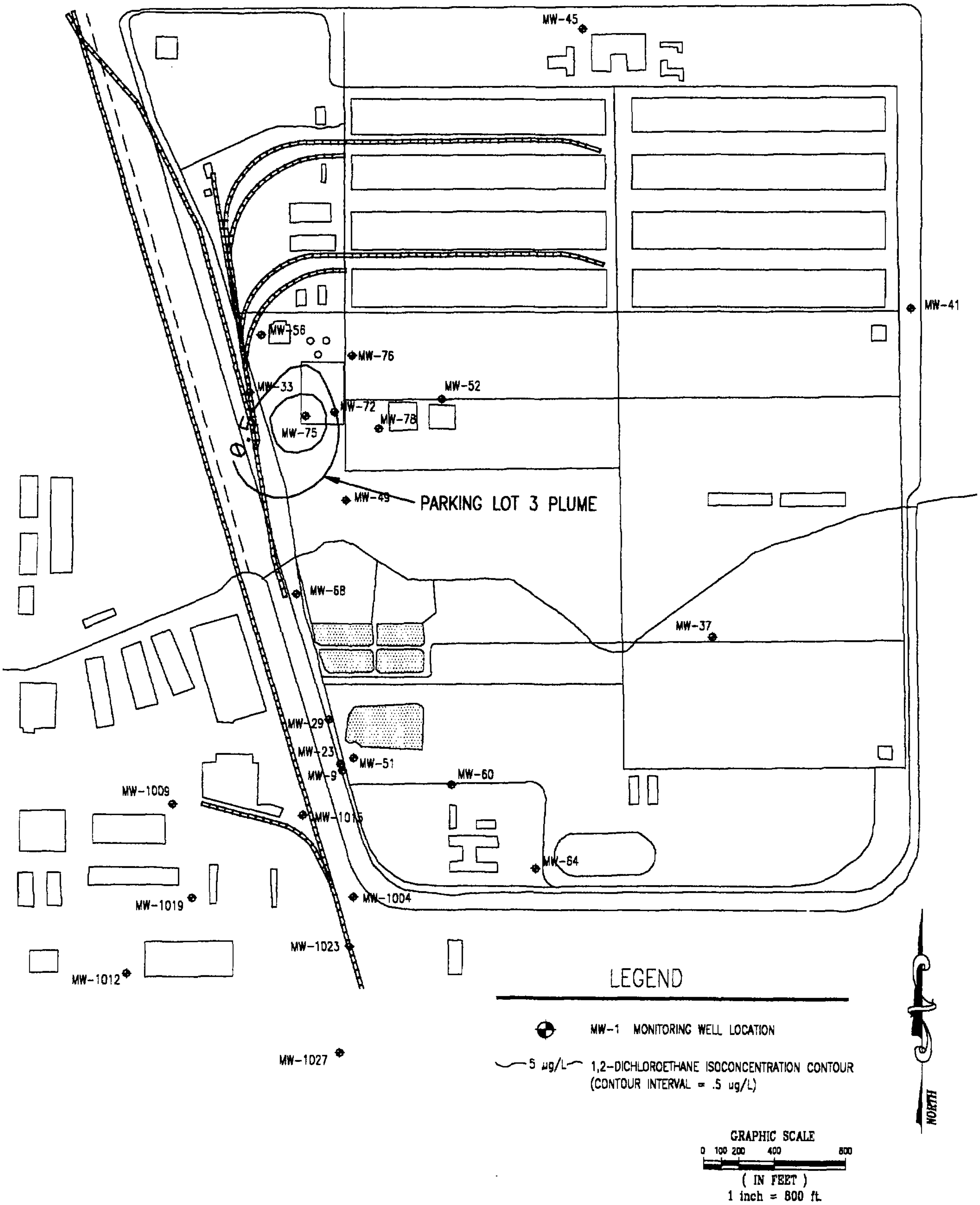


LEGEND

MW-1 MONITORING WELL LOCATION

5 µg/L CARBON TETRACHLORIDE ISOCONCENTRATION CONTOURS B - ZONE
(CONTOUR INTERVAL = 1.0 ug/L)

KLEINFELDER		CARBON TETRACHLORIDE ISOCONCENTRATION CONTOURS B – ZONE (4/94 THROUGH 8/94) SACRAMENTO ARMY DEPOT	PLATE 15
DRAWN BY: L.D./B.W.	DATE: 12–29–94		
PROJECT No. 24–150035–H05	DWG No. 35H05–07		



KLEINFELDER

1, 2 – DICHLOROETHANE EXCEEDING FRG IN ZONE B (4/94 THROUGH 8/94)

SACRAMENTO ARMY DEPOT

PLATE 16

DRAWN BY: L.D./B.W.	DATE: 12-29-94
PROJECT No. 24-150035-H05	DWG No. 35H05-11

The greatest risks to human health and the environment from exposure to groundwater contaminants at Parking Lot 3 are the possible ingestion or inhalation of vapors from groundwater by humans, if a new drinking water well was installed into the Zone A/B aquifer at Parking Lot 3. Human exposure to the current maximum concentrations of detected contaminants in the A/B groundwater zone from this hypothetical well at Parking Lot 3 (i.e., trichloroethene, carbon tetrachloride, tetrachloroethene, and 1,2-dichloroethane) would result in a maximum cancer risk of $5x10^{-5}$ and a maximum non-cancer risk of 0.4 for potential future residents. Potential future industrial workers exposed to the maximum current concentrations of groundwater contaminants would have maximum cancer and non-cancer risks of approximately $3x10^{-5}$ and 0.2, respectively. These risk levels are within the risk level ranges acceptable to the U.S. EPA for Superfund sites.

It should be noted that contaminated groundwater is not currently being used for domestic (household) or industrial purposes at the depot. Natural attenuation and degradation will gradually decrease the current low residual concentrations. In addition, based on gradient data the Parking Lot 3 plume will eventually be captured by the South Post groundwater extraction system.

In summary, the air sparging pilot test removed most of the mass of constituents from groundwater at Parking Lot 3. The remaining dilute concentrations do not represent a threat to human health or the environment.

Under this sub-alternative, aquifer restoration would be accomplished through natural attenuation and degradation of contaminants in the groundwater. However, the contaminants in this area could eventually be captured by the extraction system at the South Post Area. The Army will continue to monitor chromium. The state RWQCB believes that this sub-alternative would not comply with state ARARs because it has not been demonstrated that the groundwater would be remediated to the groundwater cleanup standards.

7.2.2 Sub-Alternative 2 - Extraction / Treat GW Using Existing SPGWTP

This sub-alternative consists of groundwater pumping from extraction wells at and south of Parking Lot 3. Detailed design will be completed to optimize the extraction system. Currently, the Army plans to use EW-8 and EW-9, which were installed as pilot wells for design purposes. EW-8 is located at the approximate center of Parking Lot 3 and EW-9 is located south of Parking

Lot 3 and west of Building 412, as shown on Plate 17. Both wells were installed in 1993 but have not been activated. Limited pumping from EW-8 and EW-9 will accelerate contaminant concentration reduction at Parking Lot 3. The extracted groundwater from the two wells would be pumped to the existing SPGWTP for treatment and then discharged to the sewer. The maximum total pumping rate (including extracted water from EW-8 and EW-9) from the treatment system to the sewer will not exceed 450 GPM.

This sub-alternative is protective of human health and the environment in the same ways as sub-alternative 1 above. Furthermore, contaminant concentrations would be reduced to their FRG levels (primary MCLs) more quickly than by sub-alternative 1. It is estimated that this sub-alternative will achieve remediation of the Parking Lot 3 groundwater in 6 years. However, implementation of this alternative will take away a small portion of available flow capacity which may slightly slow the remediation progress in the South Post Area.

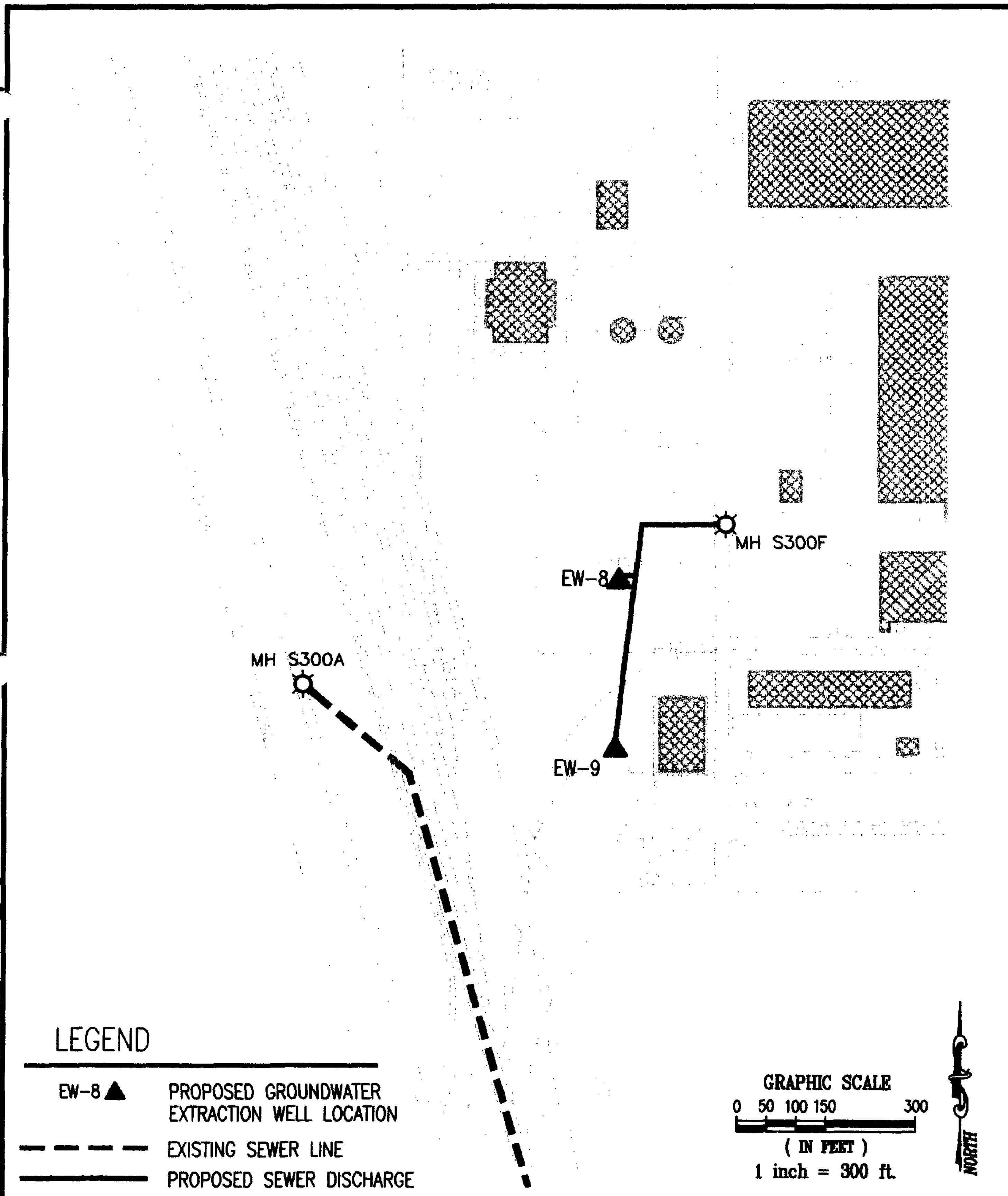
This sub-alternative will comply with ARARs. Compliance is achieved by extracting groundwater to at least FRGs (in accordance with state and national primary drinking water standards), treating the groundwater to meet pretreatment standards of the Sacramento Regional Sanitation District, and designing and operating tanks to RCRA standards.

7.2.3 Sub-Alternative 3 - Extraction / Discharge Groundwater Directly to POTW

This sub-alternative is the same as sub-alternative 2 described above, with the exception that the extracted groundwater from EW-8 and EW-9 will be treated at the wellheads using activated carbon and the treated water will then be directly discharged to the Sacramento Regional Sanitation District Sewer Treatment Plant. The maximum contaminant concentrations in the groundwater, in the area of Parking Lot 3, meet the pretreatment requirements of the Sacramento Regional Sanitation District. Therefore, no additional treatment prior to discharge will be required. Discharge requirements are described in SADA's operating permit issued by the Sanitation District. However, the activated carbon will be used to ensure permit compliance. Additionally, the treated water at Parking Lot 3 could be reused.

This sub-alternative will meet the criterium of overall protection of human health and the environment in the same ways as sub-alternative 2.

This sub-alternative will comply with ARARs. Compliance is achieved by extracting groundwater to at least MCLs (in accordance with state and national primary drinking water



KLEINFELDER

EXTRACTION WELL LOCATIONS
PARKING LOT 3 GROUNDWATER

SACRAMENTO ARMY DEPOT

PLATE 17

DRAWN BY: L. DANG	DATE: 2-28-95
PROJECT No. 24-150029-A51	DWG No. SA305-17

standards) and by meeting the pretreatment standards of the Sacramento Regional Sanitation District.

Implementability of this sub-alternative is dependent on the continued acceptance of current permit conditions by the Regional District.

7.3 BUILDING 300 BURN PIT SOIL

Each of the sub-alternatives presented below would be applied to remediate approximately 2100 cubic yards of soil located within the western burn pit area. Contaminants of concern are arsenic, cadmium and lead.

7.3.1 Sub-Alternative 1 - No Action

Under this sub-alternative, no remedial action would be taken at the Building 300 Burn Pit. The soil would be left in-place at its current condition.

Implementation of the "No Action" sub-alternative would not provide protection of human health or the environment. Public exposure to contaminant concentrations exceeding the FRGs would be possible through dermal contact, inhalation, and/or ingestion of metals from the soil at the Building 300 Burn Pit. Potential risk to the future on-site worker via the above exposure pathways is estimated to be $2x10^{-5}$ for cancer risks and 0.6 for non-cancer risks. Although these risk levels are within the ranges that are generally acceptable to the U.S. EPA for Superfund sites, some of the contaminants at Building 300 are persistent in the environment and therefore, the "No Action" sub-alternative would not be protective of the environment. Additionally, the burn pit may potentially contain unknown risks such as hazardous debris.

Since the "No Action" sub-alternative is not protective of human health and the environment, no action is not a valid remedial option and will be used for comparative purposes only.

7.3.2 Sub-Alternative 2 - Capping

This sub-alternative consists of the placement of a cap over the Building 300 Burn Pit. At the Building 300 Burn Pit, waste has been found in the borings to a depth of 16.5 feet below the ground surface with a footprint of approximately 5,200 sq. ft. Cap design must consider possible soil settlement, maintenance requirements over the long term, and compliance with cap design regulations.

In general, all loose soils experience some degree of settlement and this settlement is an important factor to consider in cap design. The degree of settlement is dependent upon how well the fill was compacted, its depth, when it was placed and the composition. This burn pit has been filled for many years, is relatively shallow, and settlement has, therefore, already occurred to a significant degree. Except for wood, the fill in the burn pit does not appear to be putresible. Therefore, it is estimated that gas formation, differential settlement or excessive settlement will not occur.

Clay has been selected for this cap design. Compacted clay offers low permeability which decreases rainwater infiltration and leachate production. It is a commonly used material and has self-sealing properties. Clay will be imported. Placement of the clay cap will be done by an experienced contractor with the proper equipment and following strict QA/QC procedures.

For the purpose of this design, the cap will be extended a perpendicular distance of ten feet beyond the footprint. This adds an additional 4,400 square feet of area, bringing the total area to be capped to 10, 200 square feet. After capping, the burn pit surface will be returned to its current use, either a grassy area or asphalt driveway.

For most landfills in California, a cap consists of three layers--foundation, barrier, and vegetative. The foundation layer is made up of soil (although waste can be used in some instances) and provides a stable base for placement of the remainder of the cap. In the case of the Building 300 Burn Pit, the existing soil will be used as the foundation layer. Overlying the foundation layer is the barrier layer, one foot of 1×10^{-6} cm/sec permeability or less of compacted clay. Overlying the barrier layer is the 1-foot minimum thick vegetative layer. The purpose of this layer is to protect the barrier layer. A two foot thick vegetative layer (double the minimum requirement of one foot for extra protection from surface activities such as reconstruction of the asphalt driveway) would be placed on top to protect the barrier layer.

Once the cap is constructed, maintenance will involve periodic monitoring of the cap for erosion damage, subsidence, or unwanted vegetation. Problems would be noted and corrected as necessary. If damaged or subsided areas are noted, additional clay would be brought in for the repair.

The human health risk for soil at the Building 300 Burn Pit is due to contact with surface soil (e.g., by ingestion, dermal absorption, or inhalation of vapors or dust from surface soil). This alternative will protect human health by capping the soil at the burn pit to eliminate the potential surface exposures. The contaminants at the Building 300 Burn Pit have not been found to threaten groundwater. However, the cap will provide an added measure of protection for the environment by further reducing any limited potential for downward migration.

This sub-alternative will comply with ARARs. Regulations and compliance issues applicable to capping of the Building 300 Burn Pit include SWRCB waste discharge to land requirements and SMAQMD air emissions requirements. Compliance is achieved by maintaining the current basewide groundwater monitoring program during cap installation, by designing the cap in accordance with SWRCB regulations, and by controlling atmospheric discharges and fugitive dust during construction of the cap.

The cap at the Building 300 Burn Pit will be effective in reducing health risks to the public and the environment by restricting surface exposure; however, the heavy metals and other contaminants will be left in the ground. The cap will require routine maintenance to ensure its integrity. With proper maintenance the remediation will be essentially permanent. Future land use restrictions will need to be placed on the area capped so that the cap is not disturbed.

7.3.3 Sub-Alternative 3 - Excavate / Stabilize (in-place)

This sub-alternative consists of the excavation and stabilization of approximately 2,100 cubic yards (3,360 tons) of in-situ soils from the Building 300 Burn Pit. The excavated soils will be stabilized at the Building 300 site by mixing the soils with cement. Stabilization criteria will be based on best achievable results measured by the Toxic Characteristic Leaching Procedure (TCLP) test and the Waste Extraction Test with deionized water (DI-WET)

Following stabilization of the Building 300 Burn Pit soil, the stabilized material will be placed back in the excavation. A clean soil cover or cap will then be placed over the stabilized material and the site restored to original conditions.

Debris removed from the burn pit excavation will be washed and properly disposed of off-site or crushed and used as aggregate in the stabilization process.

Stabilizing soil from the Building 300 Burn Pit will be protective of both human health and the environment. The stabilization process will bind the detected heavy metals in the soil with cement, forming a concrete mixture and thereby eliminating human exposure through dermal adsorption, ingestion, or the inhalation of fugitive dust. The stabilization produces a waste with non-detectable leachate concentrations for the heavy metals. Since migration of the metals cannot occur, the environment (e.g., groundwater) is protected.

This sub-alternative will comply with ARARs. Regulations and compliance issues applicable or relevant and appropriate to excavation, stabilization and on-site disposal of the Building 300 Burn Pit soil include: RCRA tank requirements, waste treatment standards, and SMAQMD air emissions requirements. Compliance is achieved by designing and operating tanks used during the stabilization process to meet RCRA standards; by adhering to land disposal requirements for replacement of the stabilized soil into the original excavation; by washing any hazardous debris encountered in the burn pit; and by controlling atmospheric discharges and fugitive dust during construction activities.

This sub-alternative is effective and permanent for stabilization of soil from the Building 300 Burn Pit. The cement/soil mass can be expected to last indefinitely. The stabilized soil mass will be "rock" hard and nearly impossible to disturb. Degradation of the soil concrete is not expected to occur since organics are generally not present. A clean soil cover will be constructed over the stabilized material to allow for future construction activity.

Short-term risks exist for the stabilization of soil from the Building 300 Burn Pit. During excavation and soil stabilization, workers could come in contact with the contaminated soil. There is a chance of contact with unknown materials in the Building 300 Burn Pit, although there has been no evidence of contaminated debris in the remedial investigation. Workers will follow all safety guidelines for work on a hazardous waste site, wearing personal protective equipment as required, and continuously monitoring ambient air quality. Equipment will be maintained on-site during excavation of the burn pit which could be used, if needed, to isolate any unknown debris, should this be encountered. The surrounding community of SADA will not be exposed to hazardous materials during remedial activities associated with soil stabilization, with the possible exception of a slight, temporary increase of dust during excavation and soil treatment which will be controlled through the use of dust control technologies and covering of excavated materials. Air monitoring will document the success of dust control technologies.

7.3.4 Sub-Alternative 4 - Excavate / Consolidate / Stabilize (CAMU)

This sub-alternative is the same as sub-alternative 3 above, except the soil and debris removed from the Building 300 Burn Pit will be consolidated with material from the South Post Burn Pits for treatment and disposal.

After excavation of the Building 300 Burn Pit, the contaminated soil will be transported to the South Post area for treatment in accordance with the South Post Burn Pits ROD amendment. The South Post area will be the location of Corrective Action Management Unit (CAMU). The Building 300 Burn Pit soil will be included in the stabilization process of the South Post Burn Pits soil since the same constituents of concern are involved.

Stabilizing soil from the Building 300 Burn Pit will be protective of both human health and the environment. The stabilization process will bind the detected heavy metals in the soil with cement, forming a concrete mixture and thereby eliminating human exposure through dermal adsorption, ingestion, or the inhalation of fugitive dust. The stabilization produces a waste with non-detectable leachate concentrations for the heavy metals. Since migration of the metals cannot occur, the environment (e.g., groundwater) is protected.

This sub-alternative will comply with ARARs.

The long-term effectiveness and permanence of sub-alternative 4 is the same as sub-alternative 3, discussed above. Additionally, the creation of a Corrective Action Management Unit results in a centralized location for all stabilized soil. This is more protective than having several smaller areas of stabilized soil at various locations. The CAMU will facilitate the use of deed restrictions for future land use in order to further protect against disturbance of the stabilized material.

7.4 BATTERY DISPOSAL WELL INVESTIGATION DERIVED WASTE (SOIL)

Each sub-alternative considered below would be applied to remediate approximately 400 tons of inviestigation-derived waste (IDW) soil and debris contaminated with heavy metals. This waste is currently stored in 16 bins located along the north side of building 555.

7.4.1 Sub-Alternative 1 - Off-site Disposal

This sub-alternative consists of the off-site disposal of the Battery Disposal Well investigation-derived waste (soil) to a permitted disposal facility. The soil is currently stored in 16 bins located north of Building 555.

This sub-alternative is protective of human health and the environment because soil contaminants (heavy metals) would be removed, eliminating potential exposures at the depot. Furthermore, potential risks to receptors at or near the landfill in which the metal-contaminated soil would be deposited would also be minimal, due to the construction of and practices conducted at Class I landfills.

This sub-alternative will comply with ARARs. Off-site disposal of soil from the Battery Disposal Well Area will comply with all appropriate laws and regulations.

7.4.2 Sub-Alternative 2 - Consolidate / Stabilize (CAMU)

Under this sub-alternative the IDW soil will transported to the South Post Burn Pits area which is within the Corrective Action Management Unit (CAMU).

Stabilizing the IDW soil will be protective of both human health and the environment. The stabilization process will bind the detected heavy metals in the soil with cement, forming a concrete mixture and thereby eliminating human exposure through dermal adsorption, ingestion, or the inhalation of fugitive dust. The stabilization process produces a waste with non-detectable leachate concentrations for the heavy metals. Since migration of the metals is not expected to occur, the environment will also be protected. Residual concentrations of metals remaining in soil (0-20 feet bgs) at the Battery Disposal Well are not a risk to human health or the environment.

This sub-alternative will comply with ARARs.

This sub-alternative is effective and permanent for stabilization of soil from the Battery Disposal Well bins. The cement/soil mass can be expected to last indefinitely. The stabilized soil mass will be "rock" hard and nearly impossible to disturb. Degradation of the soil concrete is not expected to occur since organics are generally not present. A clean soil cover will be constructed over the stabilized material to allow for future construction activity. The CAMU will facilitate the use of deed restrictions to further protect against disturbance of the stabilized material.

8 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The sub-alternatives for each area of concern (AOC) were assessed using the nine evaluation criteria developed to address CERCLA requirements. The nine criteria are:

Threshold Criteria

1) Overall Protection of Human Health and the Environment
2) Compliance with ARARs

Primary Balancing Criteria

3) Long-term Effectiveness and Permanence
4) Reduction of Toxicity, Mobility, or Volume through treatment
5) Short-term Effectiveness
6) Implementability
7) Cost

Modifying Criteria

8) State Acceptance
9) Community Acceptance

The following sections compare the sub-alternatives for each of the four AOCs in terms of the nine criteria. The comparisons are summarized in Table 9.

8.1 SOUTH POST GROUNDWATER

8.1.1 Criterion 1: Overall Protection of Human Health and the Environment

The protection of human health and the environment for each sub-alternative is obtained by extracting the contaminants using various pumping schemes or, for sub-alternative 5, by using a combination of air sparging and pumping. The comparison of sub-alternatives for protection of human health and the environment is made on the basis of the time required to reduce

TABLE 9
SUMMARY COMPARISON OF REMEDIAL SUB-ALTERATIVES
SACRAMENTO ARMY DEPOT

Area of Contamination	SUB ALT	SELECTION CRITERIA						
		Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-term Effectiveness and Permanence	Reduction of Toxicity, Mobility, and Volume	Short-term Effectiveness	Implementability	Estimated Cost $1,000
South Post Groundwater Plume	1 No Further Action (continue pumping at current flowrate using existing GW extraction system)	Protective of human health and the environment. May achieve goals in 21 years.	May comply with ARARs.	Effective and permanent. Contaminants are gradually removed from subsurface. Residual contaminants in groundwater will be below MCLs.	Toxicity is reduced by mineralizing VOCs. Mobility is reduced by establishing a hydraulic barrier to further migration. Volume is reduced by removing the contaminants from the subsurface through pumping. Capture estimated at 90%.	Effective. No new construction is required.	Easily implementable. The ground-water extraction and treatment system is already inplace and operating.	$4,300
	2 Groundwater Exraction Using Existing System; Increase Flowrate to 450 GPM	Protective of human health and the environment. May achieves goals in 18 years.	May comply with ARARs.	Effective and permanent. Contaminants are removed from the subsurface at a faster rate than sub-alternative 1. Residual contaminants in groundwater will be below MCLs. Monitoring will continue for a period following completion of remediation.	Toxicity is reduced by mineralizing VOCs. Mobility is reduced by establishing a hydraulic barrier to further migration. Volume is reduced by removing the contaminants from the subsurface through pumping. Reductions occur at a faster rate due to the increased pumping rate. Capture is 100%.	Effective. Modifications to the treatment plant to increase capacity are easily made without risk of additional exposures. No emissions or residuals result from the treatment process.	Easily implementable Groundwater extraction and treatment system is already inplace and operating. Upgrade of treatment plant to 450 GPM is routine construction. Capacity rights to discharge additional flow is achieved by decreasing other flows to the POTW.	$4,200
	3 Existing System; Increased Flowrate; Add Off-Base Extraction Wells	Protective of human health and the environment. May achieves goals in 8 years.	May comply with ARARs.	Effective and permanent. Contaminants are removed from the subsurface at a faster rate than sub-alternatives 1 and 2. Residual contaminants in groundwater will be below MCLs.	Toxicity is reduced by mineralizing VOCs. Mobility is reduced by establishing a hydraulic barrier to further migration. Volume is reduced by removing the contaminants from the subsurface through pumping. Reductions occur at a faster rate due to the increased pumping rate and strategic well placement.	Effective. Construction associated with additional extraction wells may result in brief exposures to construction workers; however, potential exposures are easily controlled with engineered controls and worker safety training. Modifications to the treatment plant to increase the capacity to 450 GPM are easily made without risk of addtional exposures.	Implementable, however, horizontal well technology is new and innovative. Limited number of contractors are available for horizontal well drilling. Real estate leases are necessary for off-base drilling, although off-base disruption is minimized with use of horizontal wells. Capacity rights to discharge additional flow is achieved by decreasing other flows to the POTW.	$4,100
	4 Existing System; Increased Flowrate; Add Off-Base Extraction Wells; Add Zone C Extraction Well	Protective of human health and the environment. Achieves goals in 8 years.	Complies with ARARs.	Effective and permanent. Contaminants are removed from the Zone C aquifer at a faster rate than sub-alternatives 1, 2 & 3. Residual contaminants in groundwater will be below MCLs.	Toxicity is reduced by mineralizing VOCs. Mobility is reduced by establishing a hydraulic barrier to further migration. Volume is reduced by removing the contaminants from the subsurface through pumping. The toxicity, mobility, and volume of contaminants in the Zone C aquifer are reduced at a faster rate than sub-alternative 3.	Effective. Construction associated with additional extraction wells may result in brief exposures to construction workers; however, potential exposures are easily controlled with engineered controls and worker safety training. Modifications to the treatment plant to increase the capacity to 450 GPM are easily made without risk of addtional exposures.	Implementable, however, horizontal well technology is new and innovative. Limited number of contractors are available for horizontal well drilling. Real estate leases are necessary for off-base drilling, although off-base disruption is minimized with use of horizontal wells. Capacity rights to discharge additional flow is achieved by decreasing other flows to the POTW.	$4,600

TABLE 9
SUMMARY COMPARISON OF REMEDIAL SUB-ALTERATIVES
SACRAMENTO ARMY DEPOT

Area of Contamination	SUB ALT	SELECTION CRITERIA						
		Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-term Effectiveness and Permanence	Reduction of Toxicity, Mobility, and Volume	Short-term Effectiveness	Implementability	Estimated Cost $1,000
	5 Groundwater Extraction Using Existing System; Add 6 Off-site Extraction Wells; Air Sparge & Soil Vent; Add Zone C Extraction	Protective of human health and the environment. Achieves goals in 9 years.	Complies with ARARs	Effective and permanent. Contaminants are removed from the subsurface through pumping and volatilization of organics. Residual contaminants in groundwater will be below MCLs. Air sparging, and associated vapor extraction, will reduce the time required for groundwater to reach FRGs.	Air sparging and associated soil venting will reduce the mobility and volume of contaminants in the groundwater by stripping the volatile organics. Toxicity is reduced through the use of an air pollution control device.	The air sparging system requires a substantial amount of off-site construction. Due to the large number of wells, substantial safety measures will be required. Large volumes of cuttings and development water will need to be covered, treated and properly disposed. Safety procedures will need to be implemented during carbon vessel recharging.	Implementation may be difficult. Off-site access for numerous wells will be required. Off-site remediation and GW extraction wells are potentially disruptive and may be challenged by off-site landowners.	$7,000
Parking Lot 3 Groundwater Plume	1 No Further Action	Protective of human health and the environment. Meets goals in 9 years.	May not comply with ARARs.	Effective in the long-term provided exposure to groundwater does not occur. Chromium will be monitored.	Toxicity will be reduced through dilution and biodegradation of organic constituents. The volume of impacted groundwater and the mobility of contaminants in the groundwater will not be reduced. Chromium will be evaluated.	Effective. No new construction is required. A potential exposure exists if new wells are installed into the affected aquifer before natural attenuation is complete. However, installation of a new well does not result in unacceptable risk levels.	Easily implementable. No new construction or remedial actions are required.	$990
	2 Extraction; Treat GW Using SPGWTP	Protective of human health and the environment. Meets goals in 6 years.	Complies with ARARs.	Effective and permanent. Contaminants are gradually removed from subsurface. Residual contaminants in groundwater will be below MCLs.	Toxicity is reduced by mineralizing VOCs. Mobility is reduced by establishing a hydraulic barrier to further migration. Volume is reduced by removing the contaminants from the subsurface through pumping. Does not destroy chromium.	Effective. Brief exposures to workers could occur, but are easily controlled using construction safety procedures. Modifications to the existing treatment plant for the additional flow are easily made without risk of additional exposures.	Implementable. Construction required to incorporate wells with the existing extraction system is routine.	$1,300
	3 Extraction; Treat using activated carbon; Discharge to POTW	Protective of human health and the environment. Meets goals in 6 years.	Complies with ARARs.	Effective and permanent. Contaminants are gradually removed from subsurface. Residual contaminants in groundwater will be below MCLs.	Mobility is reduced by establishing a hydraulic barrier to further migration. Volume is reduced by removing the contaminants from the subsurface through pumping. Toxicity will be reduced through treatment with activated carbon.	Effective. Only limited construction risk will be created. Extracted groundwater is pretreated prior to discharge.	Implementable.	$1,200

TABLE 9
SUMMARY COMPARISON OF REMEDIAL SUB-ALTERATIVES
SACRAMENTO ARMY DEPOT

Area of Contamination	SUB ALT	SELECTION CRITERIA						
		Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-term Effectiveness and Permanence	Reduction of Toxicity, Mobility, and Volume	Short-term Effectiveness	Implementability	Estimated Cost $1,000
Building 300 Burn Pit Soil	1 No Action	Not protective of human health and the environment. This sub-alternative fails the detailed assessment and will not be evaluated further.	-------	-------	-------	-------	-------	$0
	2 Capping	Protective of human health and the environment.	Complies with ARARs.	Effective in reducing health risks by restricting surface exposure. Heavy metals and other contaminants will be left in the ground. The cap will require routine maintenance. Future land use restrictions will need to be placed on the area capped so that the cap is not disturbed.	Capping will not reduce the toxicity or volume of the contaminants in the soil. Mobility of the contaminants may be reduced.	Exposures during construction of the cap are very low, since only clean soil is excavated. However, workers will follow all hazardous waste safety guidelines and ambient air will be monitored.	Easily implemented. Capping will be accomplished using standard construction techniques	$496
	3 Excavate / Stabilize (in-place) / On-site Disposal	Protective of human health and the environment.	Complies with ARARs.	Effective and permanent. The cement/ soil mass can be expected to last indefinitely. A clean soil cover will be constructed over the stabilized material to allow for future construction activity.	Soil stabilization will reduce toxicity and mobility of the contaminants by locking the constituents in a cement matrix and preventing interaction of the constituent with the environment. The volume of contaminants in the soil will remain the same.	Short-term risks exist. During excavation and soil stabilization, workers could come in contact with the contaminated soil. There is also a chance of contact with unknowns, which may be encountered in the burn pit. Dust control technologies and air monitoring will be implemented to reduce exposures to dust.	Excavation and stabilization of soils will be implemented by a contractor specializing in the process of soil excavation, stabilization, and backfill placement. The stabilization contractor will design the cement:soil ratios using treatability tests as a guide.	$617
	4 Excavate / Consolidate / Stabilize / On-site Disposal (CAMU)	Protective of human health and the environment.	Complies with ARARs.	Effective and permanent. The cement/ soil mass can be expected to last indefinitely. A clean soil cover will be constructed over the stabilized material to allow for future construction activity. The creation of a corrective action management unit (CAMU) results in a centralized location for all stabilized soil and will facilitate the use of deed restrictions for future land use in order to further protect against disturbance of the stabilized material.	Soil stabilization will reduce toxicity and mobility of the contaminants by locking the constituents in a cement matrix and preventing interaction of the constituent with the environment. The volume of contaminants in the soil will remain the same.	Short-term risks exist. During excavation, soil stabilization, and the transportation of materials to the CAMU, workers could come in contact with the contaminated soil. There is also a chance of contact with unknowns, which may be encountered in the burn pit. Dust control technologies and air monitoring will be implemented to reduce exposures to dust.	Excavation and stabilization of soils will be implemented by a contractor specializing in the process of soil excavation, stabilization, and backfill placement. The stabilization contractor will design the cement:soil ratios using treatability tests as a guide Stabilization of Building 300 Burn pit soils will be easier to accomplish as an addition to the stabilization already planned for the South Post Burn Pits.	$491

TABLE 9
SUMMARY COMPARISON OF REMEDIAL SUB-ALTERATIVES
SACRAMENTO ARMY DEPOT

Area of Contamination	SUB ALT	SELECTION CRITERIA						
		Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-term Effectiveness and Permanence	Reduction of Toxicity, Mobility, and Volume	Short-term Effectiveness	Implementability	Estimated Cost $1,000
Battery Disposal Derived Waste Soil	1 Off-site Disposal	Protective of human health and the environment.	Complies with ARARs.	Effective and permanent. Contaminated soil is physically removed from the site. The contaminated soil will no longer be under the direct control of the Sacramento Army Depot.	Toxicity, mobility and volume will no longer be relevant at the Depot since no contaminants will be present. At the off-site disposal facility, mobility will be controlled using standard landfill construction and operating procedures. Toxicity and volume may or may not be reduced depending on whether or not the contaminated soil undergoes treatment prior to disposal.	Short-term risks exist for the off-site disposal of soil. During loading and transportation operations workers could come in contact with the contaminated soil. Workers will be required to follow all hazardous waste safety guide-lines.	Easily implementable. The bins of metal contaminated soil can readily be transported and disposed of at a Class I landfill.	$80
	2 Consolidate / Stabilize / On-site Disposal (CAMU)	Protective of human health and the environment.	Complies with ARARs.	Effective and permanent. The cement/ soil mass can be expected to last indefinitely. A clean soil cover will be constructed over the stabilized material to allow for future construction activity. The creation of a corrective action management unit (CAMU) results in a centralized location for all stabilized soil and will facilitate the use of deed restrictions for future land use in order to further protect against disturbance of the stabilized material.	Soil stabilization will reduce toxicity and mobility of the contaminants by locking the constituents in a cement matrix and preventing interaction of the constituent with the environment. The volume of contaminants in the soil will remain the same.	Short-term risks exist. During soil stabilization and the trans-portation of the bins to the CAMU, workers could come in contact with the contaminated soil. Dust control technologies and air monitoring will be implemented to reduce exposures to dust.	Stabilization of BDW soils will be implemented by a contractor specializing in the process of soil stabilization and backfill place-ment. The stabilization contractor will design the cement:soil ratios using treatability tests as a guide. Stabilization of the BDW soils can be easily accomplished as an addtion to the stabilization already planned for the South Post Burn Pits.	$53

NOTES:

1) State acceptance to be evaluated after the agency comment period for the Basewide Feasibility Study and the Proposed Plan.

2) Community acceptance to be evaluated after the public comment period for the Proposed Plan.

residual concentrations in the shallow groundwater to FRGs. All times are estimates based on the basewide groundwater modeling.

Sub-alternative 1 requires 21 years. Sub-alternative 2 requires 18 years. Sub-alternative 3 requires 8 years. Sub-alternative 4 requires 8 years. Sub-alternative 5 requires 9 years for remediation of this area of contamination. Therefore sub-alternatives 3 and 4 rank highest for this criterion, and sub-alternative 1 ranks lowest.

8.1.2 Criterion 2: Compliance with ARARs

These sub-alternatives may comply with ARARs with proper design of tanks and treatment devices and by gradually reducing the groundwater concentrations to at least MCLs. The primary difference is with the time required to achieve reductions as discussed above. These sub-alternatives are judged equal for compliance with ARARs.

8.1.3 Criterion 3: Long-term Effectiveness and Permanence

These sub-alternatives achieve long-term effectiveness and permanence by removing the contaminants from the subsurface. This removal is achieved at varying rates as noted above. These sub-alternatives are judged equal against this criterion.

8.1.4 Criterion 4: Reduction of Toxicity, Mobility, and Volume

These sub-alternatives achieve reductions in contaminant volume by removing the contaminants from the ground. Subalternative 1 captures about 90% of the plume, and therefore, is judged slightly lower for this criterion. Installing a pump in Zone C is judged to be slightly more positive for remediation of this zone, and therefore, Sub-alternatives 4 and 5 have an edge for this criterion.

8.1.5 Criterion 5: Short-term Effectiveness

The short-term effectiveness is good for all sub-alternatives, but slightly lower for sub-alternative 5. The drilling of six off wells will create potential short-term exposures to the offsite public that must be carefully controlled with barriers and other safety measures.

8.1.6 Criterion 6: Implementability

The most implementable sub-alternative is 1. This involves operating the existing system as is. Sub-alternative 2 is only slightly less implementable, requiring some construction activity at the SPGWTP and adjustments to the existing wells. Sub-alternative 5 is the least implementable, requiring offsite access for six extraction wells and numerous horizontal wells. Sub-alternatives 3 and 4 are equally implementable. Launch areas for the two horizontal wells will be on-base and create little off-base disturbance. Leases should be easily obtained.

8.1.7 Criterion 7: Cost

Sub-alternatives 1, 2, 3 and 4 are close in cost. Sub-alternative 5 is considerably more expensive at $7,000,000.

8.1.8 Criterion 8: State Acceptance

The state has accepted the selected alternative.

8.1.9 Criterion 9: Community Acceptance

A public comment period was held November 22 - December 21, 1994. A public meeting was held on December 7, 1994. The community expressed no objections to the Army's preferred remedy.

8.2 PARKING LOT 3 GROUNDWATER

8.2.1 Criterion 1: Overall Protection of Human Health and the Environment

Sub-alternatives 2 and 3 are equally protective of human health and the environment. Each will pump groundwater until the concentration of all constituents reaches FRGs. This is estimated to require six years. Sub-alternative 1 is estimate to reach FRGs using natural attenuation and biodegradation in nine years.

8.2.2 Criterion 2: Compliance with ARARs

Sub-alternative 1 and sub-alternatives 2 and 3 comply with ARARs. The difference is in the time they require to reach FRGs, as discussed in Section 8.1.1.

8.2.3 Criterion 3: Long-term Effectiveness and Permanence

These sub-alternatives are judged to comply equally with this criterion.

8.2.4 Criterion 4: Reduction of Toxicity, Mobility, and Volume

Sub-alternatives 2 and 3 reduces the volume of contamination in the subsurface by removing the contaminant. Sub-alternative 1 relies on natural degradation to achieve volume reduction. This sub-alternative is rated somewhat lower than sub-alternatives 2 and 3 for this criterion.

8.2.5 Criterion 5: Short-term Effectiveness

Short-term effectiveness for sub-alternative 1 is slightly lower due to the longer period of time needed to reach FRGs. Sub-alternative 2 requires construction, which carries some risk of exposure or spreading of contaminants. Sub-alternative 3 is judged slightly higher for this criterion.

8.2.6 Criterion 6: Implementability

Sub-alternative 1 is readily implementable. Sub-alternative 3 is easily implementable, requiring a pump and piping installation. Sub-alternative 2 requires somewhat longer pipe runs.

8.2.7 Criterion 7: Cost

Sub-alternative 1 has the lowest cost at $990,000 for the long term monitoring program. Sub-alternative 3 is the next lowest cost at $1,200,000. Sub-alternative 2 costs $1,300,000.

8.2.8 Criterion 8: State Acceptance

The state has accepted the selected alternative.

8.2.9 Criterion 9: Community Acceptance

A public comment period was held November 22 through December 21, 1994. A public meeting was held on December 7, 1994. The community expressed no objections to the Army's preferred remedy.

8.3 BUILDING 300 BURN PIT SOIL

8.3.1 Criterion 1: Overall Protection of Human Health and the Environment

No action does not protect human health due to possible dermal contract with and inhalation of dust. Accordingly, no action was not evaluated further. The other sub-alternatives are capping, excavation with stabilization in place, and excavation with transport to the Corrective Action Management Unit in the South Post area for stabilization. Capping is protective of human health by isolating the contamination from the surface by an impermeable and maintained cap. Stabilization is equally protective since both procedures will successfully prevent future exposures to dust or direct dermal contact.

8.3.2 Criterion 2: Compliance with ARARs

The three sub-alternatives are judged equal for compliance with ARARs. The cap can be constructed to comply with ARARs. The capping project will likely require the installation of monitoring devices to ensure the capping is successful. Stabilization in place can be performed to comply with ARARs. Monitoring and capping of the stabilized mass is not anticipated since the stabilization produces an inert solid. Transportation of the soil to the CAMU requires regulatory approval of the CAMU. If the CAMU is not approved, sub-alternative 3 cannot be selected.

8.3.3 Criterion 3: Long-term Effectiveness and Permanence

Capping is effective and permanent but does require maintenance and restrictions on certain activity in the area such as drilling or excavating. Stabilization is designed for permanence and to be "rock hard" against any type of disturbance. The two stabilization sub-alternatives are therefore judged to be more permanent than capping, and are equal to each other.

8.3.4 Criterion 4: Reduction of Toxicity, Mobility, and Volume

Capping does not provide for reduced toxicity, mobility, or volume of contaminants. Stabilization does reduce the mobility and toxicity of contaminants. Consolidation of the soil with other soils in the CAMU will reduce the total area of contamination at the depot by placing all stabilized soil in one location.

8.3.5 Criterion 5: Short-term Effectiveness

Capping (sub-alternative 2) has a higher short-term effectiveness than the other two sub-alternatives since the contaminants are never handled. The other sub-alternatives require excavation, resulting in short-term exposures from dust. Dusting will be minimized by engineering controls and monitoring. Sub-alternative 4 has a higher short-term effectiveness compared to sub-alternative 3 since only one stabilization work station is needed under the CAMU. Sub-alternative 3 requires a separate stabilization and debris washing system setup at the Building 300 Burn Pit area.

8.3.6 Criterion 6: Implementability

Implementability of sub-alternatives 2 and 4 are judged to be equally implementable. Each requires mobilization of excavation and earth hauling equipment. Sub-alternative 3 is not as easily implemented since a new stabilization and debris washing work station must be purchased and constructed for the area. This is specialized equipment and mobilization times can be high.

8.3.7 Criterion 7: Cost

The cost for sub-alternative 2, capping, is estimated to be $496,200. The cost for sub-alternative 3 is $617,100 and for sub-alternative 4 is $491,800.

8.3.8 Criterion 8: State Acceptance

The state has accepted the selected alternative.

8.3.9 Criterion 9: Community Acceptance

A public comment period was held November 22 - December 21, 1994. A public meeting was held on December 7, 1994. The community expressed no objections to the Army's preferred remedy.

8.4 BATTERY DISPOSAL WELL INVESTIGATION-DERIVED WASTE (SOIL)

8.4.1 Criterion 1: Overall Protection of Human Health and the Environment

The two sub-alternatives are equally protective of human health and the environment. Sub-alternative 1, offsite disposal, is protective by moving the soil to a landfill designed for management of soil containing heavy metals. Sub-alternative 2, onsite disposal using stabilization, produces a waste incapable of harm to humans or the environment. Therefore sub-alternatives 1 and 2 are equally protective.

8.4.2 Criterion 2: Compliance with ARARs

The sub-alternatives comply with ARARs equally. On-site disposal requires regulatory approval of the Corrective Action Management Unit. The soil stabilization system must comply with RCRA regulations for tank design and operating safety. Offsite disposal must comply with transportation regulations.

8.4.3 Criterion 3: Long-term Effectiveness and Permanence

The sub-alternatives are judged equally effective and permanent in the long term. Offsite disposal is dependent on the quality of design of the landfill for permanence. Long-term effectiveness for the site is absolute since the soil is no longer onsite. Permanence for onsite disposal is dependent on adequate stabilization of the soil and maintaining the stabilized soil to be free from future excavation. The stabilization produces an inert solid with no tendency to leach.

8.4.4 Criterion 4: Reduction of Toxicity, Mobility, and Volume

Offsite disposal reduces the toxicity, mobility and volume of contaminants onsite by removing them to an offsite location, but otherwise does not reduce toxicity and volume. Mobility is reduced by placement into a controlled landfill environment. Onsite disposal with stabilization reduces the toxicity and mobility of the contaminants by permanently locking them into a cement matrix. Sub-alternative 2 is, therefore, judged slightly higher against this criterion.

8.4.5 Criterion 5: Short-term Effectiveness

Offsite disposal is more effective in the short term since there is less contact with the soil and contact is over a shorter period of time. Stabilization will require dust control and other safety measures. Sub-alternative 1 is, therefore, judged slightly better at short-term effectiveness.

8.4.6 Criterion 6: Implementability

Both sub-alternatives are equally implementable unless the CAMU is not approved. In that case, offsite disposal would have to be selected over onsite disposal.

8.4.7 Criterion 7: Cost

Offsite disposal is estimated to cost $80,400 and incorporation of the soils into the CAMU is estimated to cost $53,600.

8.4.8 Criterion 8: State Acceptance

The state has accepted the selected alternative.

8.4.9 Criterion 9: Community Acceptance

A public comment period was held November 22 - December 21, 1994. A public meeting was held on December 7, 1994. The community expressed no objections to the Army's preferred remedy.

9 SELECTED REMEDY

The selected basewide remedy consists of groundwater cleanup, soil cleanup, and a no action decision. In addition, two previous RODs which addressed Operable Units area being amended.

9.1 GROUNDWATER CLEANUP

The groundwater remedy consists of the following:

- In the South Post area, sub-alternative 4 is selected. Subject to detailed design, one vertical off-depot well and two horizontal off-depot wells will be installed to capture the plume more quickly. A deeper "C" zone well will be installed to pump this zone more rapidly. Pumps and piping changes will increase the treatment facility throughput to a maximum of 450 gallons per minute. Discharge of treated water will be to the sanitary sewer. However, SADA will continue to attempt to secure an on-site or off-site industrial or other reuse of treated groundwater as part of the remedy, as long as reuse costs are economically feasible within the existing allocated discharge costs of the South Post Groundwater Treatment Plant. The process flow diagram is illustrated on Plate 18.

- At Parking Lot 3, sub-alternative 3 is selected. Vertical extraction wells will be installed, one within the parking lot and one south of Parking Lot 3, to accelerate groundwater capture in this area. Treatment will be at the wellheads using carbon adsorption. Discharge of treated water will be to the sanitary sewer. The process flow diagram is illustrated on Plate 19.

Groundwater cleanup standards are set at the federal or more stringent state Maximum Contaminant Levels, which are listed in Table 10 for constituents of concern at SADA. These cleanup standards comply with the groundwater ARARs listed in Tables A-1 and A-2.

The goal of this remedial action is to restore groundwater to its beneficial use, which at this site, according to EPA's National Groundwater Policy, is a potential drinking water source. Based on information obtained during the remedial investigation and on a careful analysis of all remedial alternatives, the Army, EPA, and the State of California believe that the selected

8.3.9 Criterion 9: Community Acceptance

A public comment period was held November 22 - December 21, 1994. A public meeting was held on December 7, 1994. The community expressed no objections to the Army's preferred remedy.

8.4 BATTERY DISPOSAL WELL INVESTIGATION-DERIVED WASTE (SOIL)

8.4.1 Criterion 1: Overall Protection of Human Health and the Environment

The two sub-alternatives are equally protective of human health and the environment. Sub-alternative 1, offsite disposal, is protective by moving the soil to a landfill designed for management of soil containing heavy metals. Sub-alternative 2, onsite disposal using stabilization, produces a waste incapable of harm to humans or the environment. Therefore sub-alternatives 1 and 2 are equally protective.

8.4.2 Criterion 2: Compliance with ARARs

The sub-alternatives comply with ARARs equally. On-site disposal requires regulatory approval of the Corrective Action Management Unit. The soil stabilization system must comply with RCRA regulations for tank design and operating safety. Offsite disposal must comply with transportation regulations.

8.4.3 Criterion 3: Long-term Effectiveness and Permanence

The sub-alternatives are judged equally effective and permanent in the long term. Offsite disposal is dependent on the quality of design of the landfill for permanence. Long-term effectiveness for the site is absolute since the soil is no longer onsite. Permanence for onsite disposal is dependent on adequate stabilization of the soil and maintaining the stabilized soil to be free from future excavation. The stabilization produces an inert solid with no tendency to leach.

8.4.4 Criterion 4: Reduction of Toxicity, Mobility, and Volume

Offsite disposal reduces the toxicity, mobility and volume of contaminants onsite by removing them to an offsite location, but otherwise does not reduce toxicity and volume. Mobility is reduced by placement into a controlled landfill environment. Onsite disposal with stabilization reduces the toxicity and mobility of the contaminants by permanently locking them into a cement matrix. Sub-alternative 2 is, therefore, judged slightly higher against this criterion.

8.4.5 Criterion 5: Short-term Effectiveness

Offsite disposal is more effective in the short term since there is less contact with the soil and contact is over a shorter period of time. Stabilization will require dust control and other safety measures. Sub-alternative 1 is, therefore, judged slightly better at short-term effectiveness.

8.4.6 Criterion 6: Implementability

Both sub-alternatives are equally implementable unless the CAMU is not approved. In that case, offsite disposal would have to be selected over onsite disposal.

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Offsite disposal is estimated to cost $80,400 and incorporation of the soils into the CAMU is estimated to cost $53,600.

8.4.8 Criterion 8: State Acceptance

The state has accepted the selected alternative.

8.4.9 Criterion 9: Community Acceptance

A public comment period was held November 22 - December 21, 1994. A public meeting was held on December 7, 1994. The community expressed no objections to the Army's preferred remedy.

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9.1 GROUNDWATER CLEANUP

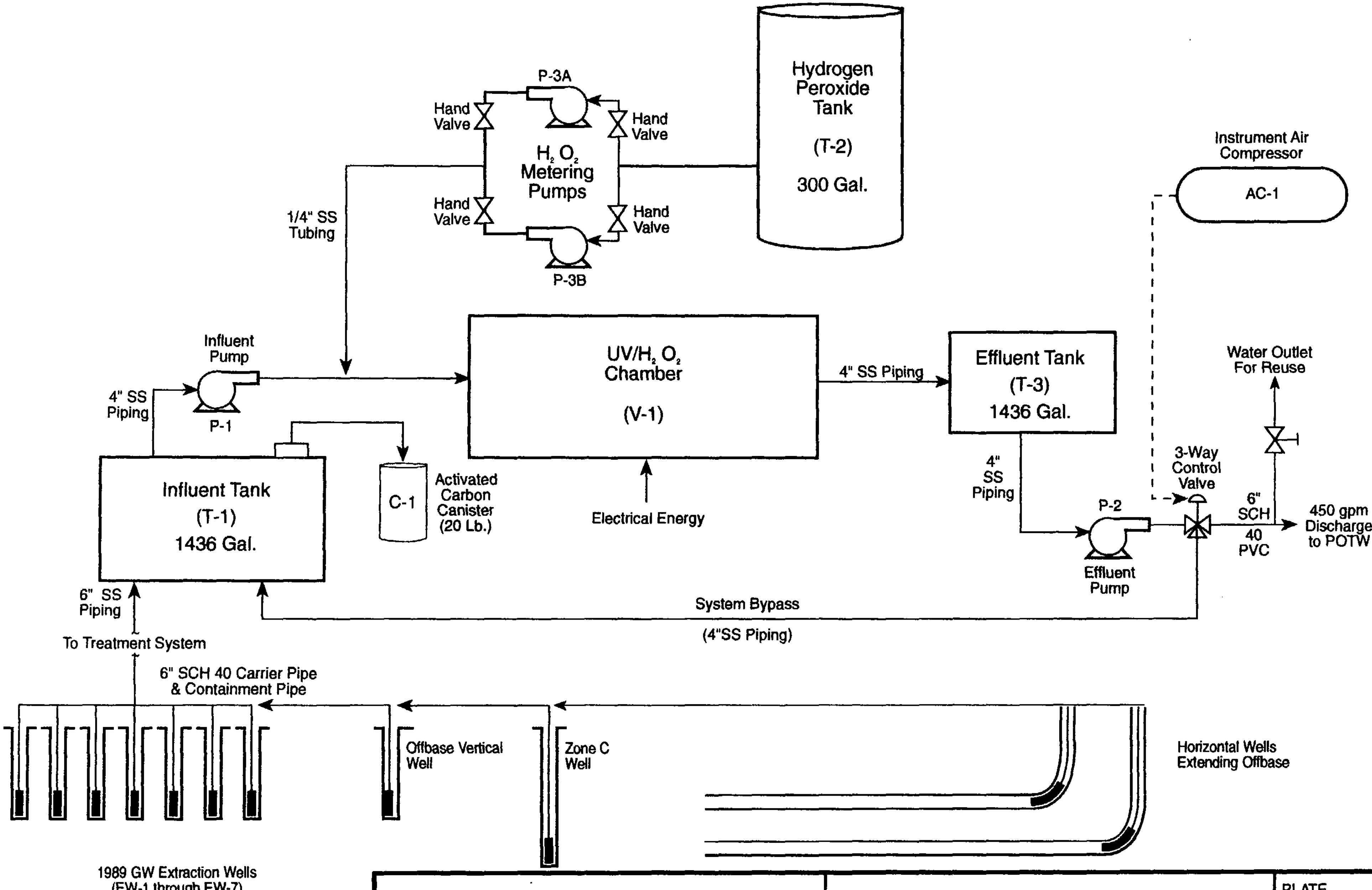
The groundwater remedy consists of the following:

- In the South Post area, sub-alternative 4 is selected. Subject to detailed design, one vertical off-depot well and two horizontal off-depot wells will be installed to capture the plume more quickly. A deeper "C" zone well will be installed to pump this zone more rapidly. Pumps and piping changes will increase the treatment facility throughput to a maximum of 450 gallons per minute. Discharge of treated water will be to the sanitary sewer. However, SADA will continue to attempt to secure an on-site or off-site industrial or other reuse of treated groundwater as part of the remedy, as long as reuse costs are economically feasible within the existing allocated discharge costs of the South Post Groundwater Treatment Plant. The process flow diagram is illustrated on Plate 18.

- At Parking Lot 3, sub-alternative 3 is selected. Vertical extraction wells will be installed, one within the parking lot and one south of Parking Lot 3, to accelerate groundwater capture in this area. Treatment will be at the wellheads using carbon adsorption. Discharge of treated water will be to the sanitary sewer. The process flow diagram is illustrated on Plate 19.

Groundwater cleanup standards are set at the federal or more stringent state Maximum Contaminant Levels, which are listed in Table 10 for constituents of concern at SADA. These cleanup standards comply with the groundwater ARARs listed in Tables A-1 and A-2.

The goal of this remedial action is to restore groundwater to its beneficial use, which at this site, according to EPA's National Groundwater Policy, is a potential drinking water source. Based on information obtained during the remedial investigation and on a careful analysis of all remedial alternatives, the Army, EPA, and the State of California believe that the selected

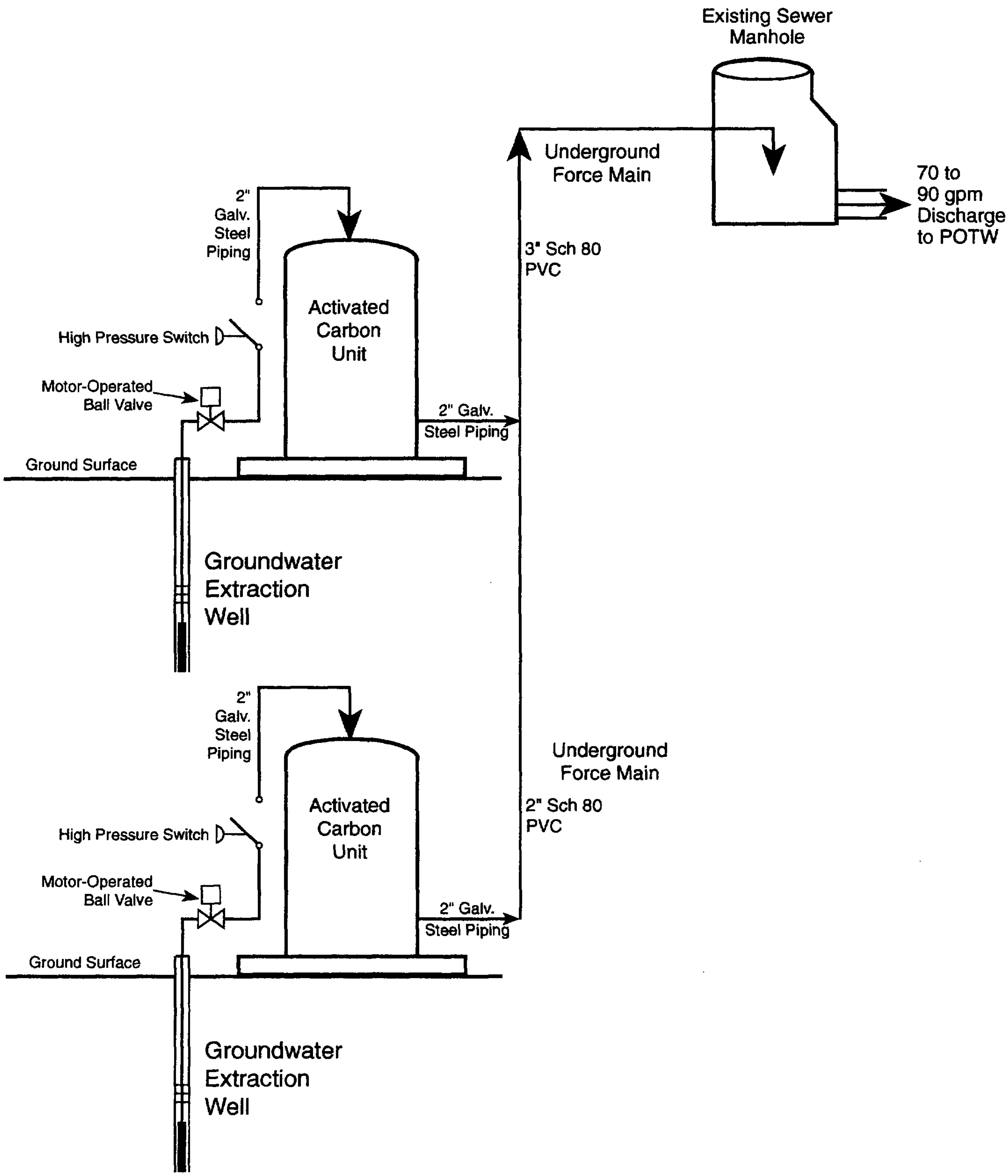


KLEINFELDER

DATE PRODUCED: 2/25/94	DATE REVISED: 12/29/94
PROJECT NO. 24-150029-A51	

PROCESS FLOW DIAGRAM
SOUTHPOST AREA
GROUNDWATER EXTRACTION AND TREATMENT
SACRAMENTO ARMY DEPOT

PLATE
18



KLEINFELDER

Drawn By: Dash Antel Project No. 24-150029-A51	Date: 10/14/94 Revised: 12/29/94	PROCESS FLOW DIAGRAM PARKING LOT 3 GROUNDWATER EXTRACTION AND TREATMENT SACRAMENTO ARMY DEPOT	PLATE 19

TABLE 10
GROUNDWATER CLEANUP LEVELS
SACRAMENTO ARMY DEPOT

CONSTITUENT	CLEANUP LEVEL, ug/l	SOURCE OF CLEANUP LEVEL
Trichloroethene	5	Federal Law
Tetrachloroethene	5	Federal Law
cis-1,2-dichloroethene	6	Federal Law
1,2-Dichloroethane	0.5	State Law
trans-1,2-dichloroethene	10	State Law
Carbon Tetrachloride*	0.5	State Law

* Carbon tetrachloride is a contaminant of concern at Parking Lot 3 only.

remedy will achieve this goal. It may become apparent, during implementation or operation of the groundwater extraction system and its modifications, that contaminant levels have ceased to decline and are remaining constant at levels higher than the remediation goal over some portion of the contaminated plume. In such a case, the system performance standards and/or the remedy may be reevaluated.

The selected remedy will include groundwater extraction for an estimated period of 9 years, during which the system's performance will be carefully monitored on a regular basis and adjusted as warranted by the performance data collected during operation. Modifications may include any or all of the following:

a) at individual wells where cleanup goals have been attained, pumping may be discontinued;

b) alternating pumping at wells to eliminate stagnation points;

c) pulse pumping to allow aquifer equilibration and to allow adsorbed contaminants to partition into groundwater; and

d) installation of additional extraction wells to facilitate or accelerate cleanup of the contaminant plume.

To ensure that cleanup goals continue to be maintained, the aquifer will be monitored in compliance with the base-wide groundwater monitoring plan and five-year review.

9.2 SOIL CLEANUP

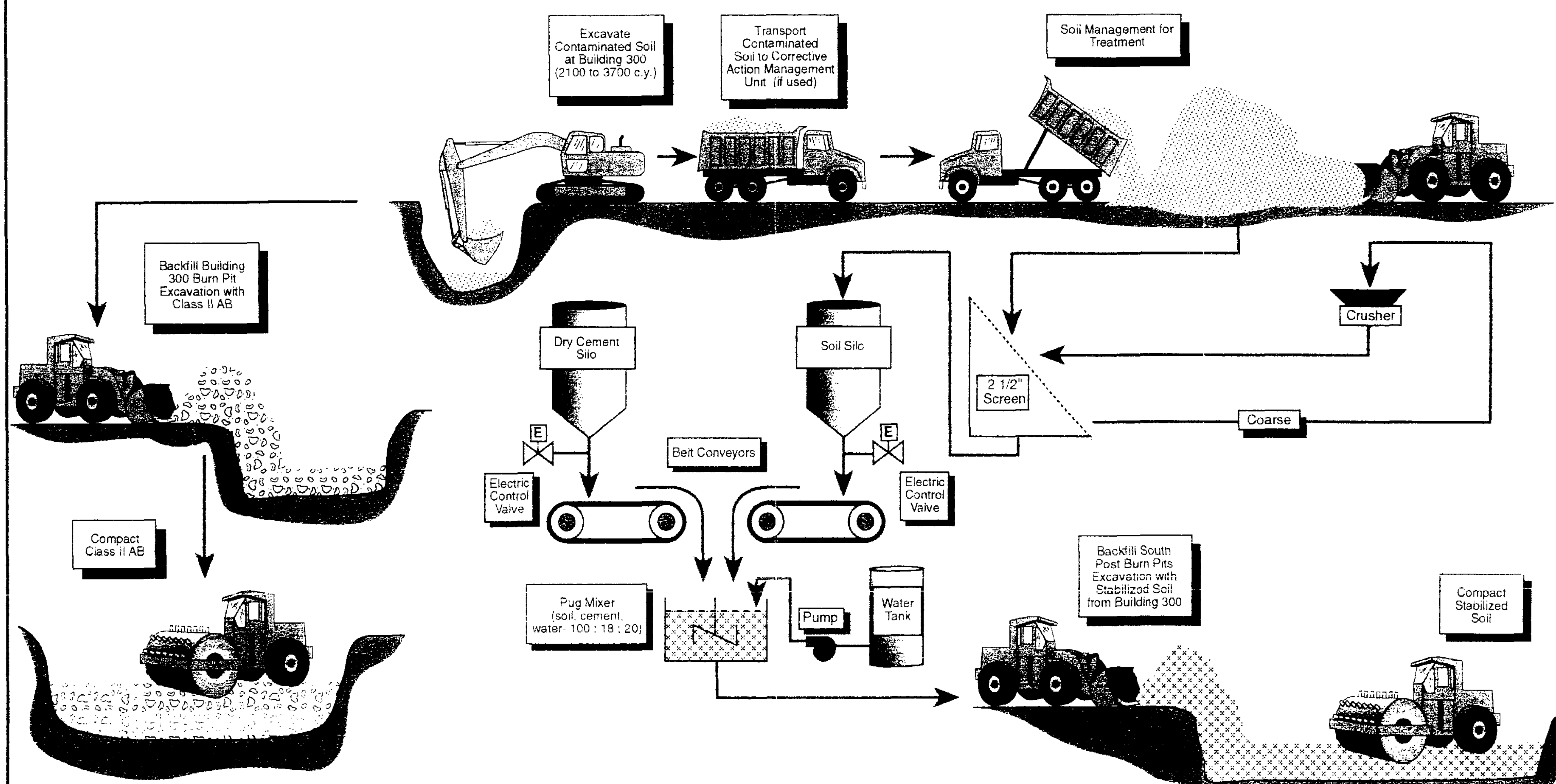
The selected remedies for the soil areas are:

- Sub-alternative 4 for the Building 300 Burn Pit. The burn pit will be excavated and the soil and debris transferred and solidified in a CAMU designated at the South Post Burn Pits Area. In accordance with the amendment to the South Post Burn Pits ROD. The process flow diagram is shown on Plate 20.

  Residual soil contamination in the Building 300 Burn Pit following the excavation will be protective of human health and the environment. Soil will be excavated at Building 300 Burn Pit until the following residual concentrations are not statistically exceeded:

Process Flow Diagram

Excavation, Stabilization, and Onsite Disposal of Soil from the Building 300 Burn Pit



KLEINFELDER		PROCESS FLOW DIAGRAM EXCAVATION, STABILIZATION AND ONSITE DISPOSAL OF SOIL FROM THE BUILDING 300 BURN PIT SACRAMENTO ARMY DEPOT	PLATE 20
DATE PRODUCED. 2/22/94	DATE REVISED. 7/8/94		
PROJECT NO. 24-150029-A51			

Metals	Residual Concentration	Source of Standard
Arsenic	7.3 mg/kg	Background
Cadmium	97 mg/kg	Risk-based
Lead	500 mg/kg	Risk-based

Soil transferred to the South Post Burn Pits CAMU will meet the treatment standards specified in the South Post Burn Pits ROD amendment.

- Sub-alternative 2 for Battery Disposal Well Investigation Derived Waste Soil. The soil will be transferred and solidified in a CAMU designated for the South Post Burn Pits area in accordance with the amendment to the South Post Burn Pits ROD. Soil transferred to the South Post Burn Pits CAMU will meet the treatment standards specified in the ROD amendment (see Section 9.4.2.1).

9.3 NO ACTION AREAS

Detailed discussion of the No Action Areas is included in Section 5. No action is selected at the Battery Disposal Well (in-situ soil), Pesticide Mix Area, Firefighter Training Area, SWMU and non-SWMU sites because they pose no threat to human health or the environment.

9.4 SOUTH POST BURN PITS ROD AMENDMENT

The South Post Burn Pits Operable Unit ROD, signed in 1993, selected SVE to remediate soils contaminated with VOCs and selected stabilization (solidification) for soils contaminated with metals. Both phases of the previously selected remedy are hereby being amended as discussed below.

9.4.1 Shutdown of SVE System at Burn Pits

With respect to the SVE system, which has an aggressive design, the system has currently reached full effectiveness and is no longer removing significant amounts of VOCs from the soil. Moreover, the technical determination has recently been made that the selected cleanup level of 5 ppbv in soil gas, as originally set forth in the 1993 ROD, cannot be attained by continued operation of the current system. This is because the 5 ppbv level, which is near the detection limit in air for TCE, is not technically feasible to attain. The technical decision has been made to shutdown the system.

9.4.1.1 Background of VOCs at Burn Pits

The Burn Pits Operable Unit consists of two pits containing soils and debris to a depth of 21 feet overlying and surrounded by natural, undisturbed soil to a depth of 86 feet where the soil becomes saturated (i.e., groundwater is encountered). Groundwater is addressed separately in this basewide ROD.

Volatile organic compounds were detected in the soil beneath the Burn Pits. Three contaminants were detected at concentrations in the soil which indicate there is a mass of contaminant in the soil which could continue to migrate downward and degrade the quality of groundwater. These contaminants were TCE, PCE, and 1,2-DCE. Goals were established in the ROD to remove 98% of the mass of TCE, 92% of the mass of PCE and 96% of the mass of 1,2-DCE. Soil gas measurement was selected as the best method to monitor the progress of the contaminant removal. However, the corresponding soil gas levels which would meet the mass removal goals stated above were not known precisely. Therefore, the soil gas level was set temporarily at the detection level for TCE until additional data became available.

9.4.1.2 Operating Results for the SVE

The Burn Pits SVE contractor, OHM, installed 12 multi-completion vent wells and 2,000 ACFM of venting capacity. Startup was completed by May 24, 1994. By mid-October, OHM estimated that all goals had been exceeded. Their system had removed 69 pounds. of TCE, 25 pounds. of PCE and 29 pounds. of 1,2-DCE. OHM further indicated that vapor concentrations at the blowers had decreased by 98% or better and that wellhead concentrations had reached non-detectable levels. Despite these data, the system was operated for an additional two months after mid-October.

9.4.1.3 Monitoring Data

An independent system monitoring the soil venting progress was installed by Kleinfelder at the Burn Pits site. The system consists of 6 permanent soil gas monitoring stations. Soil gas is monitored at 10 vertical depths at each of the six stations starting at roughly 10 feet below ground surface and extending to just above the groundwater. Soil gas samples collect from each port are analyzed for TCE, PCE and 1,2-DCE. Sampling has occurred since before the OHM system started and is ongoing at the time of this ROD.

Before startup, the highest TCE concentration in any port was 199 ug/l at 73 feet below ground surface at station No. 3 (SM-3). Using this as an example, TCE decreased steadily during the remediation operation and was reduced to 7.6 ug/l by mid-November. This remains the port with the highest concentration of TCE. All of the monitoring data are presented in regular oversite reports for remediation at the Burn Pits.

9.4.1.4 Detailed Assessment

Soil gas data can be used to estimate the subsurface mass of the contaminants. This estimate can be completed using data collected before and after the remediation effort. The analysis indicates that the initial mass of TCE below the Burn Pits was about 23 pounds. Now, after soil venting, the estimated total mass of TCE is well below one pound.

The soil gas data from the six permanent soil gas monitoring stations was averaged across the site by calculating an arithmetic average for ports at a similar depth. These averages were input into a predictive model which uses mass transfer equations to predict the contaminant concentration which will exist in soil moisture as it reaches groundwater and the time in years in the future when this will occur. Using this modeling effort it has been determined that all soil moisture entering groundwater will be below the groundwater FRG within four years. Therefore, the groundwater remediation effort at the South Post Burn Pits will not be impacted by the leaching of VOCs from the Burn Pits into groundwater.

9.4.1.5 Justification of Shutdown of SVE

Shutdown of the SVE at the Burn Pits will be protective of human health and the environment and complies with ARARs. The shutdown leaves the residual concentrations in soil well below levels which would represent a human health risk since unacceptable human health risks for the soil were not present prior to the remediation. Based on groundwater modeling, all detectable leaching is predicted to stop before the completion of the groundwater remediation program. The remaining contamination at the Burn Pits is either near the groundwater surface or already in the groundwater and is, therefore, best treated using groundwater treatment technology.

A notice of this amendment for the Burn Pits ROD was included in the Basewide Proposed Plan and all public comments have been addressed in the Responsiveness Summary (Part III of this Basewide ROD). The public did not express concerns over the change in soil gas cleanup level for soils at the Burn Pits.

9.4.1.6 Additional Verification Sampling

Additional verification sampling is planned at the Burn Pits to evaluate if soil gas concentrations change over time when the subsurface is not under vacuum. Prior to initiation of the Burn Pits stabilization, the SVE system will be temporarily shut down for a period of up to 45 days to allow soil gas levels to equilibrate. During that time period, samples will be collected to monitor residual concentrations in the soil gas and evaluate if the concentrations increase upon shutdown. If concentrations do not increase significantly, the system has met the remediation goals. If significant increases are observed, the soil gas data will be input into an acceptable model which will be used to evaluate the impact of residual concentrations in the aquifer. The Army will then assess to what extent, if any, residual soil levels will impact the planned aquifer remediation. If necessary, post-operation monitoring will be done after the stabilization is completed.
If residual soil levels will prevent the pump and treat action from achieving aquifer cleanup levels in the estimated groundwater restoration period of 9 years, additional soil remedial action will be considered.

9.4.2 Solidification/Stabilization of Additional Soils

With respect to the solidification process, the OU ROD is hereby being amended to expand the scope beyond that which was originally agreed to. The solidification process, which is scheduled to occur after the SVE is shutdown, will be expanded to include similarly contaminated soils from other areas at the depot. These areas are the Oxidation Lagoons, the Building 300 Old Burn Pit, and Investigation Derived Waste from the Battery Disposal Well. This will be facilitated by designating the South Post Burn Pits Area as a Corrective Action Management Unit (CAMU).

9.4.2.1 Substantiation of Factors Supporting a CAMU Designation

The following criteria are considered determinative for the Burn Pits Area CAMU designation:

(1) The CAMU will facilitate the implementation of a reliable, effective, protective, and cost-effective remedial action by facilitating the combination of similarly contaminated soil

from the Building 300 Burn Pit, Oxidation Lagoons Operable Unit, Battery Disposal Well investigation-derived waste, and the South Post Burn Pits Operable Unit into one remediation area which can be more effectively managed and monitored, and for which there will be increased control of future land use restrictions.

(2) Waste management activities associated with the CAMU will not create unacceptable risks to humans or the environment resulting from exposure to hazardous wastes or hazardous constituents. Exposures from windblown particulates, air emissions during excavation and transportation, or other short-term risks due to the implementation of the CAMU will be carefully controlled during remedy implementation to protect the workers and the local community.

(3) The CAMU will include uncontaminated areas of the facility because including such areas for the purpose of managing remediation waste is more protective than management of such wastes at contaminated areas of the facility. The CAMU will use these uncontaminated staging areas or accumulation points for soils that will be transported in from other areas on base in order to prepare them for treatment.

(4) Areas within the CAMU where wastes remain in place after closure of the CAMU will be managed and contained so as to minimize future releases, to the extent practicable. The wastes which will remain in place after the closure of the CAMU will be completely solidified through chemical fixation, making the possibility of any future release completely unlikely.

(5) The CAMU will minimize the land area of SADA upon which remediation wastes will remain in place after closure of the CAMU by facilitating the consolidation and solidification of soils transported from Building 300, the Oxidation Lagoons, the Battery Disposal Well, and South Post Burn Pits into one location.

The implementation of the CAMU will be in compliance with the requirements set forth in the South Post Burn Pits ROD amendment, Table A-5, regarding areal configuration of the CAMU, remediation waste management, groundwater monitoring, and closure and post-closure requirements.

Any waste that cannot be stabilized will be disposed of off-site in accordance with all appropriate laws and regulations.

9.4.2.2 Cleanup Levels

Soil will be excavated at the South Post Burn Pits, at the time of the stabilization. Residual soil concentrations after excavation will be protective of human health and the environment. Soil will be excavated at the South Post Burn Pits until the following residual concentrations are not exceeded:

Metals	Residual Concentration	Source of Standard
Cadmium	88 mg/kg	Risk-based
Total Chromium	112 mg/kg	Risk-based
Chromium (VI)	16 mg/kg	Risk based
Arsenic	7.3 mg/kg	Background
Lead	500 mg/kg	Risk-based

The Arsenic clean-up level is to local background. Local background for the depot has been found to range up to 7.3 mg/kg. Individual results may exceed this value and still be background. Compliance will be based on a statistically significant number of samples. Background may be re-evaluated in light of additional data.

Soil treated at the CAMU will be solidified so that the waste extract measured according to 40 CFR 261.24 (TCLP) meets the treatment standards specified in EPA Superfund Publication 9347.3-06FS, Obtaining a Soil and Debris Treatability Variance for Remedial Actions (Superfund LDR Guide #6A). Hazardous debris will be treated to standards specified in 22 CCR 66268.45 (see below).

Treatment Standards*				
Metals	Concentration Range (ppm)	Threshold Concentration (ppm)	Percent Reduction Range	Technology that achieves recommended effluent concentration guidance
Arsenic	0.27-1	10	90-99.9	immobilization
Cadmium	0.2-2	40	95-99.9	immobilization
Chromium	0.5-6	120	95-99.9	immobilization
Lead	0.1-3	300	99-99.9	immobilization

* *Above ppm concentrations refer to milligrams of constituent per liter of waste extract (mg/l). If the waste concentration is less than the threshold concentration, then the specified concentration range is the appropriate treatment standard. If the waste concentration is above the threshold concentration, then the specified percent reduction range is the appropriate treatment standard.*

The Army has agreed to perform the DI WET analysis as suggested by the state. Only if the analytical results exceed MCLs, do the parties agree to evaluate options for disposition of the treated soil.

9.4.2.3 ARARs

The amendment to the South Post Burn Pits ROD complies with ARARs as listed in Table A-5 in Appendix A. The ARARs set forth in the South Post Burn Pits ROD in connection with the SVE system are no longer applicable.

9.5 OXIDATION LAGOONS ROD AMENDMENT

The Oxidation Lagoons ROD was signed in September 1993. The selected remedy in the ROD was the excavation of contaminated soil and replacement of the soil back into the lagoons after treatment. The selected treatment process was washing of the soil to remove metals. The ROD is hereby being amended as discussed below.

After the ROD was signed, a large-scale pilot test of the soil washing treatment process was undertaken. The effectiveness of soil washing during the pilot test was monitored and the data were evaluated relative to remediation action objectives in the ROD. The pilot test indicated that soil washing was unreasonably costly and not reliable. Reliability is crucial because an overriding goal is to return the Oxidation Lagoons area to productive, unrestricted future uses as a clean parcel. If the soil washing process was not entirely effective, some contamination would remain. Additionally, when upsets to the process occurred, the process generated unexpectedly high volumes of wastes.

Another factor influencing the Army's decision to amend the ROD was changing regulations. The State of California passed regulations allowing the formation of Corrective Action Management Units (CAMUs). The creation of CAMUs allows the flexibility to select an appropriate site-specific, protective, reliable, and cost-effective remedy. Finally, the South Post Burn Pits ROD was signed. It had been determined that stabilization of soils at the South Post Burn Pits was the best remedial alternative. Once this was decided, the alternative of consolidating soils at the CAMU for collective management by stabilization was considerably more attractive than in previous analyses.

In summary, this amendment to the Oxidation Lagoons ROD calls for excavation of the Oxidation Lagoons soil and transport of the soil to the CAMU where it will be stabilized.

9.5.1 Cleanup Levels

Residual soil contamination in the Oxidation Lagoons following the excavation will be protective of human health and the environment. Soil will be excavated at Oxidation Lagoons until the following residual concentrations are not statistically exceeded:

Metals	Residual Concentration	Source of Standard
Arsenic	5 mg/kg	Background
Cadmium	40 mg/kg	Risk-based
Lead	500 mg/kg	Risk-based

Soil transferred to the South Post Burn Pits CAMU will meet the treatment standards specified in the South Post Burn Pits ROD amendment.

9.5.2 ARARs

The amendment to the Oxidation Lagoons ROD complies with ARARs as listed in Table A-6. The ARARs set forth in the Oxidation Lagoons ROD in connection with soil washing are no longer applicable.

9.6 COST INFORMATION

Summaries of cost information for groundwater cleanup and soil cleanup are presented in Section 7 and Table 9 and are summarized below. The cost of the selected remedy is estimated as $6,344,000. The next most likely alternative would cost $8,997,000.

Site	Selected Remedy	Alternative Remedy
South Post Groundwater	$ 4,600,000	$ 7,000,000
Parking Lot 3 Groundwater	$ 1,200,000	$1,3000,000
Building 300 Burn Pits Soil	$ 491,000	$ 617,000
Battery Disposal Well IDW	$ 53,000	$ 80,000
Total	$ 6,344,000	$ 8,997,000

10 STATUTORY DETERMINATIONS

The Army's primary responsibility at this NPL site is to undertake remedial actions that achieve adequate protection of human health and the environment. Section 121 of CERCLA establishes several statutory requirements and preferences. These specify that, when complete, the selected remedy must comply with ARARs unless a statutory waiver is justified. The selected remedy must also be cost effective, and utilize permanent solutions and alternative treatment or resource recovery technologies to the maximum extent practicable. Finally, the statute expresses a preference for treatment as a principal element that reduces TMV of the hazardous waste.

10.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedy would protect human health by removing VOCs from the groundwater, and by stabilizing heavy metals in soils. Risks posed by inhalation, ingestion, or absorption of volatile organics, and by absorption or ingestion of soil or inhalation of dust containing non-volatile contaminants would be eliminated. Heavy metals would be bound into a concrete mix that would eliminate the potential for exposure.

10.2 COMPLIANCE WITH ARARS

Section 121 of CERCLA provides that, unless waived, remedial actions shall comply with Federal and State laws that are applicable or relevant and appropriate to the contaminants and circumstances of the site. The selected remedies would meet all ARARs. The list of ARARs for the selected alternative is presented on Tables A-1 through A-6. The list of ARARs does not include several state requirements that the state (RWQCB) believes are ARARs. These requirements are portions of Title 23, CCR Division 3, Chapter 15, and State Water Resources Control Board Resolution No. 68-16 and No. 92-49, Section III.F. The state will not dispute this ROD, however, because it believes that the selected remedies will comply with substantive provisions of these requirements.

10.3 COST EFFECTIVENESS

The selected remedies are cost-effective. Sub-alternative 4 for the South Post groundwater costs about the same as sub-alternatives 1, 2 and 3 and much less than sub-alternative 5.

Similarly, sub-alternative 3 at Parking Lot 3 costs about the same as the other two sub-alternatives. For the Building 300 Burn Pit, the selected sub-alternative is lower in cost than the other two sub-alternatives. Also, for the Battery Disposal Well IDW, the selected sub-alternative is less expensive. In combination, the selected remedy overall is either the lower cost sub-alternative or substantially the same cost, to within the accuracy of the estimate, to other sub-alternatives.

10.4 UTILIZATION OF PERMANENT SOLUTIONS, AND ALTERNATIVE TREATMENT AND RESOURCE RECOVERY TECHNOLOGIES

The selected remedies represent the maximum extent to which permanent solutions and technologies can be used in a cost-effective manner. Of those alternatives that meet the threshold criteria of overall protection of human health and the environment and compliance with ARARs, the selected remedies provide the best balance of tradeoffs in terms of:

- Long-term Effectiveness and Permanence;
- Reduction of TMV;
- Short-term Effectiveness;
- Implementability; and
- Cost

10.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

The selected remedy satisfies the statutory preference for treatment as a principal element. The principal threats to human health and the environment are volatile organic chemicals in groundwater, and metals in soil. The selected remedy would address these threats through treatment by removing VOCs from the groundwater and destroying them using ultraviolet light, or in the case of Parking Lot 3, thermal destruction offsite after capture on activated carbon. Metals in soil would be immobilized by adding stabilizers to the excavated soil.

III RESPONSIVENESS SUMMARY

1 BACKGROUND ON COMMUNITY INVOLVEMENT

At various times since 1979, formal news releases have been issued by the SADA Public Affairs Office concerning contamination issues at SADA. The releases have provided the local media and general public with information on the status of investigative and remedial efforts and continuing actions to protect public health and safety.

To date, public concerns about the contamination at SADA have mainly focused on (1) the potential for exposure to contaminated groundwater that currently exists under the southwest corner of SADA and off site to the south and west of SADA, and (2) the effects that contamination and remedial actions have on public health and the environment

Contamination at SADA is not expected to affect businesses in the vicinity of the site, residential property values, or traffic patterns during site cleanup since the selected remedy will operate within the SADA facility boundary and will not significantly change the number of vehicles going to or from the Depot each day. The public has expressed no concerns with these issues. If not remediated, contaminants at SADA could pose a long-term health risk to future on-site and off-site workers. No short-term or long-term human health or environmental risks should occur during or after remediation of soil or groundwater, providing that on-site workers follow standard OSHA guidelines for working with hazardous waste during remediation and dust control measures are implement during construction. The public has expressed no concerns with short- or long-term health risks during remediation, but has expressed concern about contamination of drinking water wells.

2 OVERVIEW

Notice was placed in the local community daily newspaper announcing the availability of the Basewide Feasibility Study (OUFS) and Proposed Plan (PP) in the local information repositories at the California State University Library, the SADA Security Office, Cal-EPA, Department of Toxic Substances Control, and the George Sim Community Center. Public review and comment was invited for a period of 30 days, from November 22 to December 21, 1994. No written comments were received.

A public information and comment meeting on the PP was held on December 7, 1994 at the George Sim Community Center. The meeting was attended by 45 people, representing the public, the Army, EPA, DTSC and RWQCB. During the public comment period and the public meeting, the public had 23 questions and 4 comments.

3 SUMMARY OF PUBLIC COMMENTS AND ARMY RESPONSES

The following questions were asked at the public meeting on December 7, 1994.

Question 1:
How far had the groundwater plume traveled prior to beginning cleanup efforts?

Response:
We estimate that when we first began, the groundwater plume was about a quarter of a mile off the base.

Question 2:
How many gallons per month are being pumped out of the ground?

Response:
The treatment plant usually pumps anywhere between 12 and 13 million gallons a month. Once the new wells have been installed, the treatment plant will be pumping anywhere between 17 and 18 million gallons a month.

Question 3:
Is it possible to dump the treated water back into the well again instead of into the sewer system?

Response:
Yes, the Army has conducted a reuse study that considered putting treated groundwater back down the wells. This option was too expensive and we couldn't control the plume.

Question 4:
How do you determine what actually caused the contamination and over what period of time?

Response:
The groundwater contamination was caused by downward movement of contaminants from the South Post Burn Pits which operated from the 1950's to 1966. Rainwater washed contaminants through the soil and into the groundwater.

Question 5:

Could the groundwater flow direction change at the southwest depot?

Response:

No, the flow direction could not change in this case. Groundwater flow moves due to gravity and the gravitational direction, which, in this case, is south, southwest. The groundwater elevation is higher on the north side of the depot and is lower on the south side. Therefore, gravity will pull the water towards the south, since it has a lower elevation. Futhermore, there is not groundwater pumping anywhere else on-depot that would change the direction of flow.

Question 6:

When you are testing for different contaminants, don't you have to know specifically what you are looking for first, so that you can choose the correct test? Otherwise, you may not find it.

Response:

We knew what kinds of chemicals were used in the past. Also, when the samples are analyzed in the laboratory, certain classes of chemicals are tested for, so you don't have to know the specific chemical, only the general class you are looking for. In general, we did full scans for the various classes of chemicals before we analyzed specific chemicals.

Question 7:

How long has the depot's groundwater monitoring program been in effect?

Response:

The depot began their monitoring program over 10 years ago.

Question 8:

How many years in the future are you going to monitor the wells?

Response:

The wells will be monitored until the agencies are satisfied that the cleanup levels have been met.

Question 9:
What if new contamination begins to show up?

Response:
If new contamination is found, and it can be shown that it's a result of depot activities, the government is obligated to clean it up. If a new industry on the depot contaminates the soil and we pick it up in the groundwater, we will track it down and find the source and then the State regulators will get involved with the company that's producing that contamination.

Question 10:
Specifically, what kind of contaminants are located in the groundwater?

Response:
Solvents (e.g. Trichloroethylene)

Question 11:
What effect does Trichloroethylene have on humans?

Response:
Trichloroethylene may cause cancer.

Question 12:
Does the depot's groundwater contamination effect the drinking water?

Response:
There are no drinking wells in the area of the groundwater plume. Residents surrounding the depot area receive their drinking water from the city.

Question 13:
What is air sparging?

Response:
Air sparging is a way of cleaning up groundwater. During air sparging, air bubbles are injected into the soil below the groundwater table. The VOCs that are dissolved in the groundwater, or absorbed onto soil particles in the groundwater, become volatilized and forced upward with the

air bubbles out of the groundwater and into the soil. Then the vapors are extracted out of the soil, brought to the surface and treated.

Question 14:

Am I correct in saying that part of the decision making process leading to a particular decision, as you call it, requires analysis of cost effectiveness and estimates of the total cost of the remediation process?

Response:

Yes.

Question 15:

It's my personal opinion that it's beneficial for the general public and taxpayer to recognize the level of resources and funding that had been allocated to the clean-up of the Sacramento Army Depot. And particular, the local residents should know how much of the national tax dollars and state tax dollars have been allocated to making sure that you and your family are safe for generations. How much has been spent to date?

Response:

Through our records, which would include money spent prior to the development of the Superfund, we have spent $63,000,000.

Question 16:

Would that include the budgets for the persons who are on payroll of the Cal-EPA, Federal EPA, and any other agencies? How much is being expended within their departments or agencies? Would you say it is important or that the public has a right to know?

Response:

No, Cal-EPA, federal EPA and other agencies are not included in the $63,000,000. They are paid for out of different budgets/accounts.

Yes, the public has a right to know.

Question 17:
Would it be a reasonable statement to say that a considerable amount of resources and tax dollars have been allocated to addressing the concerns of the local community and ensuring their ongoing health?

Response:
Yes.

Question 18:
Can you tell me how much Kleinfelder has been paid to date and how much Foster Wheeler has been paid to date?

Response:
To date, Kleinfelder has been paid $23,000,000 and Foster Wheeler has received approximately $2,000,000. Of Kleinfelder's $23,000,000 various subcontractors to the firm have received about 2/3 of the total dollar amount.

Question 19:
Would it be correct in saying then that Kleinfelder and their subcontractors are basically located in the greater Sacramento area, certainly within the Northern California area and that those tax dollars have in some way come back to our community?

Response:
Yes, almost all of the consultants are located in the Sacramento area.

Question 20:
Are all the contracts in hand to carry the depot through closure? If so, is the funding for those contracts secured and if not, what can we as members of the general public do to assist and ensure that you get the funding required to finish the project?

Response:
Yes, the contracts are in hand. The community's support, and the team approach from the State, federal agencies, Corps of Engineers and the depot have been key to successful funding of this program.

Question 21:
In some documentation it was stated that this area is a seasonal wetland and that there are various forms of wildlife on the depot. What is going to happen to the rabbits, foxes and burrowing owls?

Response:
In the northwest corner of the depot there are fairy shrimp, burrowing owls, a coyote family, and rabbits.

The north-west corner of the depot has been zoned by the city as an open space habitat preserve, which will not be developed. When the property is transferred to the city they will not be able to build on this area. The Final Reuse and Disposal EIS for Sacramento Army Depot will discuss endangered species issues and possible mitigation measures.

Question 22:
Are there trees out there?

Response:

Yes, there are a few trees on the depot property.

Question 23:
I think that putting some good plant life and seeds to make plants is the natural way to clean it up and make it look good.

RESPONSE:

The property is being transferred to the city for reuse. Contact the city's Planning and Development Department to make this suggestion.

The following comments were made at the public meeting on December 7, 1994.

COMMENT 1:

The RAB Community Co-chair expressed his satisfaction with the Army's approach to cleaning up the Sacramento Army Depot. At first, the member was concerned that the Army was not forthcoming, but since becoming involved with the program, the member is happy and satisfied with the Army's remediation program.

COMMENT 2:

One community member expressed his appreciation for the opportunity to question and comment on this program. He credits the depot with an excellent job in articulating and presenting information to the community.

The member commented that any place you have a military installation, there are some foreseeable environmental problems and that it is going to cost money to clean it up. So if you have to spend -- how much is a child's life worth: $60,000,000? $100,000,000?

COMMENT 3:

A community RAB member explained their continued concern and thanked the depot for trying to answer their questions. The member appreciates the depot's community efforts and feels they go out of their way to try and get the answers when a question has been asked the can't otherwise be quickly answered.

COMMENT 4:

The president of a local Neighborhood Association thanked the Army for their efforts.

4 RESPONSIVENESS SUMMARY

The Community Relations activities relating to the Basewide Record of Decision for SADA to date have included the following:

- The Army held a public meeting on June 16, 1994 at the George Sim Community Center, 6207 Logan Street in Sacramento, California. The meeting was held to update the community on the depot's remediation status and to solicit interest in forming a Restoration Advisory Board (RAB). Minutes from the meeting are available in the Administrative Record.

- The Army developed a fact sheet to solicit community interest in forming a Restoration Advisory Board (RAB). The fact sheet was mailed out to over 8,000 residents surrounding the depot. A notice was placed in the local daily newspaper announcing the formation of the depot's RAB. Approximately 20 applications were received. RAB members were selected from the applications received.

- A RAB was established in July 1994. Members meet monthly to discuss the depot's remediation efforts.

- The Army placed notices in a local daily newspaper announcing the cleanup plan, the availability of documents in the Administrative Record and other information repositories, and an upcoming public meeting December 7, 1994. The notices invited public participation in the selection of a cleanup alternative.

- The Army issued a Proposed Plan (PP) describing the preferred basewide alternative for groundwater and soil cleanup at SADA and soliciting public involvement on November 18, 1994. The PP was mailed to contiguous property owners and numerous newspapers, radio, and television stations. In addition to the Administrative Record, the PP is available at the offices of Region IX EPA, the California EPA DTSC in Sacramento, California, and the George Sim Community Center.

- The Army held a public meeting on December 7, 1994 at the George Sim Community Center, 6207 Logan Street in Sacramento, California. The meeting was recorded by a court reporter and a written text of the meeting is available in the Administrative Record.

- The Army opened a public comment period from November 22 to December 21, 1994. No written or oral comments were received during that time, except at the public meeting on December 7, 1994 (see preceding item).

APPENDIX A

ANALYSIS OF ARARs

Table A-1 = South Post Groundwater, Selected Remedy

Table A-2 = Parking Lot 3 Groundwater, Selected Remedy

Table A-3 = Building 300 Burn Pits Soil, Selected Remedy

Table A-4 = Battery Disposal Well IDW Waste

Table A-5 = South Post Burn Pits ROD Amendment

Table A-6 = Oxidations Lagoons ROD Amendment

TABLE A-6
OXIDATION LAGOONS ROD AMENDMENT
SELECTED REMEDY
LISTING OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

ARAR	DESCRIPTION	COMPLIANCE
Rule 402 (Applicable)	General guideline, if the operation causes release of contaminants to the atmosphere, then a case-by-case determination of public nuisance potential should be performed to verify compliance. This rule states that discharges to air causing injury, detriment, nuisance, annoyance; or endangering comfort, repose, health, safety, or causing damage to business or property is prohibited.	During excavation of Oxidation Lagoons soils, the Army shall minimize the potential for emissions using BACT. A health risk assessment has been conducted to evaluate the effect of fugitive emissions on the receptors in the vicinity of the stabilization unit. Workers could come in contact with the contaminated soil during excavation and soil stabilization. Workers will follow all safety guidelines for work on a hazardous waste site, wearing pesonal protective equipment as required and continuously monitoring ambient air quality. The surrounding community of SADA will not be exposed to hazardous materials during remedial activities associated with soil stabilization, with the possible exception of a slight, temporary increase of dust during excavatin and soil treatment which will be controlled through the use of dust control technologies and covering of excavated materials. The contractor shall use perimeter air monitoring to verify the success of dust control measures. If the following values are exceeded, the contractor shall stop dust-generating work and undertake all actions necessary to eliminate dust from traveling off-site: Metal — ug/m^3 Arsenic — 0.042 Cadmium — 0.034 Copper — 35 Nickel — 0.06 Zinc — 35 Lead — 1.5
Rule 403 (Applicable)	Fugitive dust	During excavation of the Oxidation Lagoons Soils, every reasonable effort will be taken to prevent fugitive dust from extending beyond the property line. Dust control measures will include watering with addition of dust control chemicals or foams available if needed.
Rule 405 (Applicable)	Dust and Condensed fumes requirements	No discharges into the atmosphere shall be made from any source whatsoever of dust or condensed fumes in total quantities exceeding the allowable.

TA[illegible]E A-1
SOUTH PO[illegible] [illegible]ROUNDWATER
SELEC[illegible]D REMEDY
LISTING OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

ARAR	DESCRIPTION	COMPLIANCE
40 CFR 403 (Applicable)	General Pretreatment Regulations for existing and new sources of water pollution.	Groundwater pretreatment at the South Post Groundwater Treatment Plant will be continued in compliance with this chemical -specific regulation. For as long as the discharge continues to the Sacramento Regional Sanitation District, the requirements are described in SADA's operating permit issued by the Sanitation District. The higher water discharge rate of 450 gpm will have to be accomodated by allocating a greater portion of the allowable discharge capacity to the Sacramento Regional Sanitation District to the groundwater discharge.
RCRA TANKS		
22 CCR 66264.195 (Applicable)	Tank inspection schedule and procedures are outlined.	The existing groundwater treatment plant uses hydrogen peroxide, a hazardous material since it is a strong oxidant. The operation of the hydrogen peroxide tank has been and will be in compliance with this regulation. The tank is inspected and there is an emergency response plan to implement in the event of a release or accident.
22 CCR 66264.196 (Applicable)	Emergency Response.	This regulation is applicable to the H2O2 tank at the South Post Groundwater Treatment Plant. An approved emergency response plan would be implemented in response to a spill.
22 CCR 66264.197 (Applicable)	This section describes closure and post-closure care requirements for tanks.	This regulations is applicable to the H2O2 tank at the South Post Groundwater Treatment Plant. An approved closure plan will be implemented when the tanks are removed from service.
NATIONAL PRIMARY DRINKING WATER REGULATIONS		
40 CFR Part 141.61 (Relevant & Appropriate)	Establishes a maximum contaminant level of 0.005 mg/l for TCE and PCE in water served to people.	The Maximum Contaminant Levels (MCLs) for constituents in drinking water are relevant and appropriate for evaluating final remediation goals for remediation of groundwater. This sub-alternative will comply with this ARAR by restoring the aquifer over time to the Final Remediation Goal which are set not to exceed the MCLs. This restoration is achieved through pumping and groundwater containing contaminants. Federal MCLs are relevant and appropriate for tetrachloroethene (PCE) and trichloroethene (TCE).
STATE PRIMARY DRINKING WATER REGULATIONS		
22 CCR 64444.5 (Relevant & Appropriate)	Sets maximum levels for constituents in drinking water supplied to the public.	The Maximum Contaminant Level (MCLs) for constituents in drinking water are relevant and appropriate for evaluating final remediation goals for remediation of groundwater. This sub-alternative will comply with this ARAR by restoring the aquifer over time to the Final Remediation Goals which are set not to exceed the MCLs. This restoration is achieved by pumping of the aquifer in zones of maximum exceedance of the FRGs. State MCLs are relevant and appropriate for 1,2-dichloroethane, cis-1,2-dichloroethene, and carbon tetrachloride.

T/ `E A-1
SOUTH PO! ROUNDWATER
SELEC, _D REMEDY
LISTING OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

ARAR	DESCRIPTION	COMPLIANCE
GROUNDWATER MONITORING REQUIREMENTS		
22 CCR 66264.97 (b) and (e)	RCRA Groundwater Monitoring Requirements	The Army will install sufficient monitoring points to fully evaluate the effectiveness of the remedial action and will comply with the general monitoring requirements in this section.
Water Quality Control Plan (Basin Plan) for the RWQCB, CVR. (Applicable). Chapter 2 Beneficial Uses: Municipal and Domestic, Agricultural, and Industrial Supply; Chapter 3 Water Quality Objectives: Chemical Constituents	Specific applicable portions of the Basin Plan include beneficial uses of affected water bodies and water quality objectives to protect those uses. Any activity, including, for example, a new discharge of contaminated soils or in-situ treatment or containmnet of contaminated soils, that may affect water quality must not result in water quality exceeding water quality objectives.	The ground water cleanup standards are set at the most stringent water quality objectives, which protect the ground water for beneficial use of drinking water.
State Water Resources Control Board Resolution No. 88-63 ("Sources of Drinking Water Policy") (as contained in the RWQCB's Water Quality Control Plan) (Applicable)	Determines beneficial uses for waters that may be affected by discharges of waste.	Specifies that, with certain exceptions, all ground and surface waters have the beneficial use of municipal or domestic water supply.
State Water Resources Control Board Resolution No. 92-49 Section IIIG (As amended April 21, 1994) (Applicable)	Applies to all cleanups of discharges that may affect water quality. (Specifically Section III G) Establishes requirements for investigation and cleanup and abatement of discharges. Among other requirements, discharger must clean up and abate the effects of discharges in a manner that promotes the attainment of either background water quality, or the best water quality that is reasonable if background water quality cannot be restored.	The Army demonstrated in the FS Report that it would be economically infeasible to achieve background levels (i.e., non-detect for VOCs) in ground water. It appears that the ground water cleanup standards listed in Table 10 are the lowest levels that are technologically and economically achievable. These standards are set at the federal or more stringent state Maximum Contaminant Levels, and will protect the ground water for its beneficial use of drinking water.
Title 23, CCR Section 2550.4 (Applicable)	Cleanup levels must be set at background concentration levels.or, if background levels are not technologically and economically feasible, then at the lowest levels that are economically and technologically achievable. Specific factors must be considered in setting cleanup levels above background levels.	The Army demonstrated in the FS Report that it would be economically infeasible to achieve background levels (i.e., non-detect for VOCs) in the ground water. It appears that the ground water cleanup standards listed in Table 10 are the lowest levels that are technologically and economically achievable. These standards are set at the federal or more stringent state Maximum Contaminant Levels, and will protect the ground water for its beneficial use of drinking water.

TABLE A-2
PARKING LOT 3 GROUNDWATER
SELECTED REMEDY
LISTING OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

ARAR	DESCRIPTION	COMPLIANCE
GENERAL PRETREATMENT REGULATIONS		
40 CFR 403 (Applicable)	General Pretreatment Regulations for existing and new sources of water pollution.	This chemical specific regulation is applicable to the discharge of groundwater to the Sacramento Regional Sanitation District. Contaminant concentrations in the groundwater at the Parking Lot 3 Area are at levels which meet the pretreatment requirements of the Sanitation District. Extracted groundwater will be discharged in compliance with the requirements described in SADA's current operating permit issued by the Sanitation District.
NATIONAL PRIMARY DRINKING WATER REGULATIONS		
40 CFR Part 141.61 (Relevant & Appropriate)	Establishes a maximum contaminant level of 0.005 mg/l for TCE and PCE in water served to people.	The Maximum Contaminant Levels (MCLs) for constituents in drinking water are relevant and appropriate for evaluating final remediation goals for remediation of groundwater. This sub-alternative will comply with this ARAR by restoring the aquifer over time to the Final Remediation Goal which are set not to exceed the MCLs. This restoration is achieved through pumping of groundwater containing contaminants. Federal MCLs are relevant and appropriate for tetrachloroethene (PCE) and trichloroethene (TCE).
STATE PRIMARY DRINKING WATER REGULATIONS		
22 CCR 64444.5 (Relevant & Appropriate)	Sets maximum levels for constituents in drinking water supplied to the public.	The Maximum Contaminant Level (MCLs) for constituents in drinking water are relevant and appropriate for evaluating final remediation goals for remediation of groundwater. This sub-alternative will comply with this ARAR by restoring the aquifer over time to the Final Remediation Goals which are set not to exceed the MCLs. This restoration is achieved by pumping of the aquifer in zones of maximum exceedance of the FRGs. State MCLs are relevant and appropriate for 1,2-dichloroethane, cis-1,2-dichloroethene, and carbon tetrachloride.
Water Quality Control Plan (Basin Plan) for the RWQCB CVR. (Applicable) Chapter 2 Beneficial Uses: Municipal and Domestic, Agricultural, and Industrial Supply; Chapter 3 Water Quality Objectives: Chemical Constituents	Specific applicable portions of the Basin Plan include beneficial uses of affected water bodies and water quality objectives to protect those uses. Any activity, including, for example, a new discharge of contaminated soils, or in-situ treatment or containment of contaminated soils, that may affect water quality must not result in water quality exceeding water quality objectives.	The ground water cleanup standards are set at the most stringent water quality objectives, which protect the ground water for beneficial use of drinking water.

TABLE A-2
PARKING LOT 3 GROUNDWATER
SELECTED REMEDY
LISTING OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

ARAR	DESCRIPTION	COMPLIANCE
State Water Resources Control Board Resolution No. 88-63 (Sources of Drinking Water Policy") (as contained in the RWQCB's Water Quality Control Plan) (Applicable)	Determines beneficial uses for waters that may be affected by discharges of waste.	Specifies that, with certain exceptions, all ground and surface waters have the beneficial use of municipal or domestic water supply.
State Water Resources Control Board Resolution No. 92-49 Section IIIG (As amended April 21, 1994) (Applicable)	Applies to all cleanups of discharges that may affect water quality. (Specifically Section IIIG) Establishes requirements for investigation and cleanup and abatement of discharges. Among other requirements, dischargers must clean up and abate the effects of discharges in a manner that promotes the attainment of either background water quality, or the best water quality that is reasonable if background water quality cannot be restored.	The Army demonstrated in the FS Report that it would be economically infeasible to achieve background levels (i.e., non-detect for VOCs) in the ground water. It appears that the ground water cleanup standards listed in Table 10 are the lowest levels that are technologically and economically achievable. These standards are set at the federal or more stringent state Maximum Contaminant Levels, and will protect the ground water for its beneficial use of drinking water.
Title 23, CCR, Section 2550.4 (Applicable)	Cleanup levels must be set at background concentration levels, or, if background levels are not technologically and economically feasible, then at the lowest levels that are economically and technologically achievable. Specific factors must be considered in setting cleanup levels above background levels.	The Army demonstrated in the FS Report that it would be economically infeasible to achieve background levels (i.e., non-detect for VOCs) in the ground water. It appears that the ground water cleanup standards listed in Table 10 are the lowest levels that are technologically and economically achievable. These standards are set at the federal or more stringent state Maximum Contaminant Levels, and will protect the ground water for its beneficial use of drinking water.
22 CCR 66264.97 (b) and (e)	RCRA Groundwater Monitoring Requirements.	The Army will install sufficient monitoring points to fully evaluate the effectiveness of the remedial action and will comply with the general monitoring requirements in this section.

TABLE A-3
BUILDING 300 BURN PIT SOIL
SELECTED REMEDY
LISTING OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

ARAR	DESCRIPTION	COMPLIANCE
Rule 402 (Applicable)	General guideline, if the operation causes release of contaminants to the atmosphere, then a case-by-case determination of public nuisance potential should be performed to verify compliance. This rule states that discharges to air causing injury, detriment, nuisance, annoyance; or endangering comfort, repose, health, safety, or causing damage to business or property is prohibited.	During excavation at the Building 300 Burn Pit, the contractor shall minimize the potential for emissions using BACT. A health risk assessment has been conducted to evaluate the effect of fugitive emissions on the receptors in the vicinity of the stabilization unit. Workers could come in contact with the contaminated soil during excavation and soil stabilization. Workers will follow all safety guidelines for work on a hazardous waste site, wearing pesonal protective equipment as required and continuously monitoring ambient air quality. The surrounding community of SADA will not be exposed to hazardous materials during remedial activities associated with soil stabilization, with the possible exception of a slight, temporary increase of dust during excavatin and soil treatment which will be controlled through the use of dust control technologies and covering of excavated materials. The contractor shall use perimeter air monitoring to verify the success of dust control measures. If the following values are exceeded, the contractor shall stop dust-generating work and undertake all actions necessary to eliminate dust from traveling off-site:
Rule 403 (Applicable)	Fugitive dust	During excavation at the Building 300 Burn Pit, every reasonable effort will be taken to prevent fugitive dust from extending beyond the property line. Dust control measures will include watering with addition of dust control chemicals or foams available if needed.
Rule 405 (Applicable)	Dust and Condensed fumes requirements	No discharges into the atmosphere shall be made from any source whatsoever of dust or condensed fumes in total quantities exceeding the allowable.

Metal	ug/m^3
Arsenic	0.042
Cadmium	0.034
Copper	35
Nickel	0.06
Zinc	35
Lead	1.5

TABLE A-4
BATTERY DISPOSAL WELL
SELECTED REMEDY
LISTING OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

ARAR	DESCRIPTION	COMPLIANCE
SMAQMD AIR EMISSIONS REQUIREMENTS		
Rule 402 (Applicable)	General guideline, if the operation causes release of contaminants to the atmosphere, then a case-by-case determination of public nuisance potential should be performed to verify compliance. This rule states that discharges to air causing injury, detriment, nuisance, annoyance; or endangering comfort, repose, health, safety, or causing damage to business or property is prohibited.	During transport of the Battery Disposal Well Investigation Derived Waste, the contractor shall minimize the potential for emissions using BACT. A health risk assessment has been conducted to evaluate the effect of fugitive emissions on the receptors in the vicinity of the stabilization unit. Workers could come in contact with the contaminated soil during excavation and soil stabilization. Workers will follow all safety guidelines for work on a hazardous waste site, wearing pesonal protective equipment as required and continuously monitoring ambient air quality. The surrounding community of SADA will not be exposed to hazardous materials during remedial activities associated with soil stabilization, with the possible exception of a slight, temporary increase of dust during excavatin and soil treatment which will be controlled through the use of dust control technologies and covering of excavated materials. The contractor shall use perimeter air monitoring to verify the success of dust control measures. If the following values are exceeded, the contractor shall stop dust-generating work and undertake all actions necessary to eliminate dust from traveling off-site:
Rule 403 (Applicable)	Fugitive dust	During transport of the BDW IDW, every reasonable effort will be taken to prevent fugitive dust from from extending beyond the property line. Dust control measures will include watering with addition of dust control chemicals or foams available if needed.
Rule 405 (Applicable)	Dust and Condensed fumes requirements	No discharges into the atmosphere shall be made from any source whatsoever of dust or condensed fumes in total quantities exceeding the allowable.

TABLE A-5
SOUTH POST BURN PITS ROD AMENDMENT
ARARs

ARAR	DESCRIPTION	COMPLIANCE
RCRA CLOSURE		
22 CCR 66264.97 (d) and (e)	RCRA unsaturated zone monitoring	The Army will install sufficient monitoring points to fully evaluate the effectiveness of the remedial action and will comply with the general monitoring requirements in this section.
22 CCR 66264.111	Closure performance standards	The Army will develop a remedial design which complies with the substance of the requirements set forth in this section.
22 CCR 66264.112	Closure plan	The Army will develop a remedial design which complies with the substance of the requirements set forth in this section.
CORRECTIVE ACTION MANAGEMENT UNITS		
22 CCR 66264.552 (e) (1) - (4)	CAMU requirements	The remedial design shall address the following requirements for the South Post Burn Pits CAMU: 1. The areal configuration of the CAMU. 2. Requirements for remediation waste management for those areas of the CAMU that are to be used for treatment or storage of remediation wastes. 3. Monitoring requirements. 4. Closure and post-closure requirements.
22 CCR 66264.250 - 253	Waste pile requirements	The remedial designs shall address the following requirements for South Post Burn Pits CAMU: 1. Waste pile design and operating requirements. 2. Action leakage rate. 3. Response actions. 4. Monitoring and inspection.

TABLE A-5
SOUTH POST BURN PITS ROD AMENDMENT
ARARs

ARAR	DESCRIPTION	COMPLIANCE
SMAQMD AIR EMISSIONS REQUIREMENTS		
Rule 402 (Applicable)	General guideline, if the operation causes release of contaminants to the atmosphere, then a case-by-case determination of public nuisance potential should be performed to verify compliance. This rule states that discharges to air causing injury, detriment, nuisance, annoyance; or endangering comfort, repose, health, safety, or causing damage to business or property is prohibited.	For the stabilization at the CAMU the Army shall minimize the potential for emissions using BACT. A health risk assessment has been conducted to evaluate the the effect of fugitive emissions on the receptors in the vicinity of the CAMU. The Army shall use perimeter monitoring to verify the successful dust control measures. If the following values are exceeded, the contractor shall stop dust-generated work and undertake all actions necessary to eliminate dust from traveling off-site: Metal — ug/m^3 Arsenic — 0.042 Cadmium — 0.034 Copper — 35 Nickel — 0.6 Zinc — 35 Lead — 1.5
Rule 403 (Applicable)	Fugitive Dust	At the CAMU, every reasonable precaution shall be taken not to cause or allow the emissions of fugitive dust from being airborne beyond the property line from which the emissions originate. Reasonable precautions shall include, but are not limited to applying asphalt, oil, water, or suitable chemicals for the control of dust on surfaces which can give rise to airborne matter. Other measures may be taken as approved by the Air Pollution Control Officer. The Army will be required to comply with this rule.
Rule 405 (Applicable)	Dust and Condensed fumes requirements	No discharges into the atmosphere shall be made from any source whatsoever of dust or condensed fumes in total quantities exceeding the allowable.

APPENDIX B

ADMINISTRATIVE RECORD DOCUMENTS

ADMINISTRATIVE RECORD

	Administrative Record Documents	Submittal	I.D.
1.	Sacramento Army Depot Federal Facility Agreement (FFA)	Dec. 1988	SW-35
2.	Proposed Plan for On-site Ground Water Remediation	June 16, 1989	GW-11
3.	Proposed Plan for On-site Ground Water Operable Unit Feasibility Study (OUFS)	May 19, 1989	GW-10
4.	Public Health Evaluation Phase II OUFS Ground Water Treatment System	April 1989	GW-8
5.	Record of Decision Ground Water Treatment System	Sept. 28, 1989	GW-13
6.	Listing of CERCLA Response Selection Guidance Documents Consulted for Proposed		AR-1
7.	Notice of Availability of Proposed Plan; and Notice of Intent to Adopt a Negative Declaration	July 31, 1989	AR-2
8.	Meeting Minutes from Remedial Project Managers (RPMs) Meetings and Restoration Advisory Board (RAB) Meetings		AR-11
9.	RCRA Part B Permit Renewal Application	April 2, 1990	AR-3
10.	Tank 2 Proposed Action Plan	August 1991	T2-5
11.	Tank 2 & Oxidation Lagoons Public Hearing Transcript	August 20, 1991	AR-12
12.	Tank 2 Operable Unit Feasibility Study (OUFS)	Oct. 1, 1991	T2-4A
13.	Tank 2 OUFS Public Health Evaluation	Oct. 1, 1991	T2-4B
14.	Tank 2 OUFS Treatability Studies	Oct. 1, 1991	T2-4C
15.	Tank 2 Record of Decision	Oct. 2, 1991	T2-6

ADMINISTRATIVE RECORD

Administrative Record Documents		Submittal	I.D.
16.	Tank 2 Operable Unit Technical Memorandum Field Activities, Appendix A-1 of Sitewide RI Report	Oct. 25, 1991	T2-7
17.	Pesticide Mix Area, Fire Fight. Training Area, Building 300 Burn Pits, Battery Disposal Well, Technical Memorandum of Field Activities, Appendix A-4 of Sitewide Remedial Investigation	Oct. 28, 1991	RI-4A/D
18.	Oxidation Lagoons Operable Unit Feasibility Study (OUFS)	Mar 13, 1992	OL-4A
19.	Oxidation Lagoons Public Health Evaluation	Mar 13, 1992	OL-4B
20.	Oxidation Lagoons Treatability Studies	Mar 13, 1992	OL-4C
21.	Tank 2 Record of Decision Fact Sheet	April 5, 1992	
22.	Oxidation Lagoons Proposed Action Plan	May 1992	OL-5
23.	Oxidation Lagoons Public Hearing Transcript	May 27, 1992	AR-13
24.	Burn Pits Public Health Evaluation (Appendix C of OUFS)	June 12, 1992	BP-3B
25.	Burn Pits Treatability Study (Appendix G of OUFS)	June 12, 1992	BP-3C
26.	Oxidation Lagoons Operable Unit Technical Memorandum of Field Activities, Appendix A-2 of Sitewide Remedial Investigation	June 30, 1992	OL-6
27.	Burn Pits Proposed Action Plan	July 1992	BP-4
28.	Burn Pits Operable Unit Technical Memorandum of Field Activities, Appendix A-3 of the Remedial Investigation	July 1992	BP-2
29.	Addendum Report to Technical Memorandum of Field Activities Burn Pits Operable Unit	July 17, 1992	BP-5
30.	Community Relations Plan Sacramento Army Depot	August 1992	SW-24

ADMINISTRATIVE RECORD

Administrative Record Documents		Submittal	I.D.
31.	Burn Pits Public Hearing Transcript	August 13, 1992	AR-14
32.	Oxidation Lagoons Record of Decision	Sept. 15, 1992	OL-7
33.	Oxidation Lagoons Record of Decision Fact Sheet	January 1993	AR-15
34.	Burn Pits Record of Decision	Feb. 23, 1993	BP-7
35.	Burn Pits Operable Unit Feasibility Study (OUFS)	Mar 30, 1993	BP-3A
36.	Basewide Health Risk Assessment	May 4, 1994	SW-29
37.	Burn Pits Record of Decision Fact Sheet	June 1993	AR-16
38.	Base Closure and Realignment Act (BRAC) Clean Up Plan	March 1, 1994	AR-17
39.	Sacramento Army Depot Reuse Plan	June 20, 1994	AR-21
40.	Tank 2 Remedial Action Plan	June 21, 1994	T2-9
41.	Basewide Feasibility Study	July 13, 1994	SW-28
42.	Ecological Risk Assessment	August 5, 1994	SW-36
43.	Sacramento Army Depot Reuse Plan Final Environmental Impact Report	Sept. 1994	AR-22
44.	Environmental Assessment for Additional Ground Water Extraction Well	Sept. 1994	AR-23
45.	Basewide Remedial Investigation	Sept. 21, 1994	SW-27
46.	Final Environmental Impact	October 1994	AR-24
47.	Basewide Proposed Action Plan	November 1994	AR-19
48.	Statement Disposal and Reuse		AR-20

TABLE 3-1
PROJECT EMISSIONS

Emissions Unit	Pollutant	Emissions pounds/hr	pounds/day	tons/year
Gas Turbines				
	NOx	5.27	126.4	23.1
	CO	1.41	33.8	6.2
	VOC	0.08	1.9	0.4
	SOx	0.03	0.7	0.1
	PM_{10}	0.67	16.1	2.9
Duct Burner				
	NOx	1.40	33.6	6.1
	CO	0.27	6.4	1.2
	VOC	0.07	1.7	0.3
	SOx	0.01	0.2	0.0
	PM_{10}	0.19	4.6	0.8
Existing Boilers				
Boiler 1[1]				
	NOx	0.95	22.9	4.2
	CO	0.24	5.7	1.0
	VOC	0.02	0.5	0.1
	SOx	0.00	0.1	0.0
	PM_{10}	0.09	2.2	0.4
Boiler 2[2]				
Project Total				
	NOx	7.62	182.9	33.4
	CO	1.92	45.6	8.4
	VOC	0.17	4.1	0.8
	SOx	0.04	1.0	0.1
	PM_{10}	0.95	22.9	4.1

1 Boiler 1 emissions are based on the boiler operating at 12% of capacity to provide steam not supplied by the cogeneration plant (see Appendix A for calculations).

2 Boiler 2 is a standby unit, which is not allowed to be operated simultaneously with Boiler 1 under the current Permit to Operate.

TABLE 4-1
STATIONARY SOURCE POTENTIAL TO EMIT

Emissions Unit	Emissions tons/year NOx	CO	VOC
Stationary Source Potential to Emit (after modification)			
Cogeneration System	29.2	7.4	0.7
Boilers	4.2	1.0	0.1
Spray Dryer	9.9	2.5	0.4
Tower Dryer	14.3	3.6	0.3
Total	57.6	14.4	1.5
Stationary Source Potential to Emit (before modification)			
Boilers	80.2	7.4	1.8
Spray Dryer	9.9	2.5	0.4
Tower Dryer	14.3	3.6	0.3
Total	104.4	13.5	2.4
Offset Quantity (SSPE after - SSPE before)	-46.8	none	none

As shown in Table 4-1, only the NOx SSPE (after modification) will exceed the trigger level of 10 tons per year for determining the quantity of offsets. According to Rule 2201, Section 6.8, the NOx offset quantity depends on the SSPE *before* the proposed project is implemented. The NOx SSPE of the existing facility is 104.4 tons per year, which is greater than 10 tons per year. Therefore, according to Section 6.8, the offset quantity is calculated by subtracting the SSPE before modification from the SSPE after modification. As shown in Table 4-1, the result of this calculation is -46.8 tons per year. Therefore, no NOx offsets are required for the proposed project.

The NSR balance is calculated for emissions of SOx and PM_{10} from new or modified sources. Offsets are required if the NSR balance exceeds 150 pounds of SOx per day or 80 pounds of PM_{10} per day. The NSR balance is determined only for emission units that have been added to a stationary source since the baseline date. The applicable baseline date in Fresno County is January 1, 1977. Of the existing equipment at the Danish Creamery, only the tower dryer and the proposed cogeneration plant have been added since the baseline date. The SOx and PM_{10} emissions from these sources are summarized in Table 4-2.